Sampling and Analysis Plan for Dominguez Channel Oil Spill

Dominguez Channel Oil Spill

Wilmington, California

Prepared by:
Crimson Pipeline L.P.
2459 Redondo Avenue
Signal Hill, California 90755

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Region 9 Quality Assurance Manager

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) is intended to document the procedural and analytical requirements for the investigation and removal of the Crimson Pipeline crude oil release that resulted from a crude oil discharge from Crimson Pipeline's 4-inch pipeline the "Youngstown Lateral," which connects to the THUMS 8-inch pipeline and crosses the Alameda Corridor Transportation Agency (ACTA) railroad right-of-way north of Pacific Coast Highway (PCH) in Wilmington, California. This SAP covers the Youngstown Lateral release area and includes the French drain system of the ACTA Right-of Way (ROW); portions of the Shell Lubes Plant south of the oil pipeline release; and continuing to the storm water collection and treatment system located near the intersection of Leeds Avenue and Grant Street.

This SAP was prepared by Crimson Pipeline (Crimson), as required by the U.S. Environmental Protection Agency, Region IX (EPA) *Order for Removal, Mitigation or Prevention of a Substantial Threat of Oil Discharge,* EPA docket number CWA 311-9-2011-0002, Section VI, No. 14. The SAP combines the basic elements of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP). The following subsections in this introduction provide the site name and location, responsible agencies, and project organization.

1.1 SITE NAME OR SAMPLING AREA

The project name the "**Dominguez Channel Oil Spill**" (hereafter referenced as the "Site"). Crude oil from the pipeline release was discharged into the a drain system associated with the Alameda Corridor rail system as described in the Project Plan and the City of Los Angeles storm water management system.

1.2 SITE OR SAMPLING AREA LOCATION

The Site includes the area of the ACT railroad ROW and adjacent properties near Wilmington, California. The area extends southward approximately 3,000 feet along the ROW from the Youngstown lateral pipeline location at the intersection of Leeds Avenue and Grant Street at the southern end of the area.

1.3 RESPONSIBLE AGENCIES

The EPA is the oversight agency for spill cleanup activities. Other agencies include the California Department of Fish and Game (CDFG), California Department of Water Resources (CDWR), and California Pipeline Safety Division (CPSD). The Unified Command for this incident is the EPA, CDFG, and Crimson. All oil removal, site investigation, and other activities associated with this event will be conducted under the direction and approval of the Unified Command.

1.4 PROJECT ORGANIZATION

The project organization is outlined in the Dominguez Oil Spill Project Plan. Titles/responsibilities, names, and contact information for the agencies, Crimson, their consultants and contractors are listed in Table 1.

TABLE 1
Key Project Personnel

Title/Responsibility	Contractors	Name	Phone Numbers	
			Office	*Cell*
EPA Project Manager (OSC)		Jason Musante		213-479-2120
Crimson Pipeline VP/Project Coordinator	Crimson Pipeline Management Company	Larry Alexander	562-595-9216	949-922-9895
Project Consultant	Beacon Energy Inc.	Mark Reese P. G.	562-997-3087	714-624-5301
California Department of Fish & Game (OSPR) Lieutenant		Bryan Gollhofer	562- 342-7214	562-708-7757
California Department of Fish & Game (OSPR) Biologist		Cory Kong	562- 342-7214	562-477-7081
California Department of Fish & Game (OSPR)		James Foto	562- 342-7214	562-598-4292
Waste Management Supervisor	WGR Southwest Inc.	Bill Senner	562-799-8510	310-629-5260
Removal Coordinator	WGR Southwest Inc.	Graydon Martz P.G.	562-799-8510	310-629-5261
Project Engineers	Stantec Consulting Corp.	Kevin K. Miskin, P.E.	909-335-6116	909-224-3406
Investigation Coordinator	Stantec Consulting Corp.	Jim DeWoody	909-335-6116	951-403-4623
Quality Assurance Officer (QAO)	Stantec Consulting Corp.	James Kerr, P.G.	970-879-3250	303-884-7125
Laboratory QA Officer	Test America Laboratory	Lena Davidkova	949-261-1022	
Environmental Compliance GIS Drafter	Beacon Energy Inc.	Valerie Muller	562-997-3087	310-809-3918

2.0 BACKGROUND

On December 21, 2010, oil was discovered in a storm water lift station owned by the City of Los Angeles. The lift station is part of a storm water drain system and is located south of the Grant Street\Leeds Avenue location. Storm water from this station discharges into the Dominguez Channel. The oil entered the storm water system from an outfall of the ACTA railroad ROW storm water drainage system. Oil was also observed migrating from the ACTA railroad ROW onto the Shell Lubes Plant. The discharged oil migrated with storm water into the Shell Lubricants facility storm water retention basin. The source of oil was subsequently determined to have originated from the Youngstown Lateral pipeline.

2.1 SITE OR SAMPLING AREA DESCRIPTION

The site is located north of the Dominguez Channel, east of South Alameda Street, west of Terminal Island Freeway, and south of PCH within the city of Wilmington, Los Angeles County, California (Figure 1 of Project Plan). The site is located at Latitude: 33.7825010, Longitude: -118.2372450. Additional figures presenting the different areas of the site are included in the Project Plan and incorporated in this SAP by reference.

The Site or sampling area occupied 300,000 square feet in an industrial area. The site or sampling area is bordered roughly on the north by Alameda Street, on the west by ACA ROW, on the south by the Grant/Leeds Avenue location, and on the east by ACRA ROW. The specific location of the Site or sampling area is shown on Figure 2 of the Project Plan.

2.2 OPERATIONAL HISTORY

Land use in the surrounding area is industrial, with petroleum refineries, transmodal shipping, and petroleum distribution facilities. Owners of adjacent properties include the City of Los Angeles, Shell Lubricants (Shell), the Port of Los Angeles (POLA), and private owners. Shell operates the Los Angeles Lubes Plant, located at 1926 East Pacific Coast Highway. ACTA operates the railroad right-of-way (ROW) that runs through the ports of Long Beach and Los Angeles, primarily along and adjacent to Alameda Street (EPA Dominguez Channel website).

As described above, the area is industrial and has been for many years. Although the past and present waste management practices of the various industrial facilities are not know at this time, there is the potential for other historical releases and/or spills to have impacted the Site study area.

2.3 PREVIOUS INVESTIGATIONS/REGULATORY INVOLVEMENT

In response to the release, EPA and ACTA preformed a number of activities designed to capture and contain crude oil along the ROW. The historical activities are described in the subsection below. Crimson has not validated the work performed, effectiveness, or completeness of those activities, but have included this information in the SAP. Samples of impacted media have been collected and analyzed. These data are summarized in Tables 2-1 to 2-3.

The following summary of emergency response actions and investigations performed by ACTA and EPA at the Site is based on information provided in various Work Plans prepared by ACTA personnel and from recent discussions with ACTA personnel. The details of the emergency response actions were provided by ACTA, EPA, and municipal agencies, and response contractors. These have been included here as reference only.

2.3.1 Modifications to Shell Source Area

Approximately 900 feet south of PCH, oily water overflowed a concrete barrier on the west side of the ACTA ROW, and flowed onto the Shell Lubes Plant. At this location (referred to as the Shell Source Area) ACTA and NRC, increased the height of the west wall using sandbags, enlarged and improved the collection of the oily/water in the excavated sump area. Detail of the emergency response actions are included below.

In December 2010, the EPA and their contractor, EQM, installed two catch basins to contain the oily water flowing from the ACTA Right of Way and excavated a sump (approximately 2 feet by 2 feet and 2 feet deep) in the ballast north of these basins.

ACTA improved the Catch Basin Area by extending the existing sandbags further along the western fence line. Additional sandbags were placed on top of the existing sandbags; increasing the height to approximately 4 feet. Plastic sheeting was then installed on the east side of the sandbags to decrease permeability. The plastic sheeting was anchored at the bottom by removing soil/ballast in an about 12-inch wide and 4-inch in depth of for the full length of the wall. The plastic sheeting was placed in this excavated area and additional row of sandbags were placed on top. The plastic sheeting was anchored at the top with an additional row of sandbags.

ACTA's subcontractors improved the sump area by installing 15-inch diameter perforated PVC pipes (wells), ranging from about 4 feet to 8 feet in length in this area. Approximately 2 feet of the PVC well was installed above grade and between 2 feet to 6 feet was installed below grade. The shorter length of pipe was placed near buried utilities such as the Shell 18-inch diameter corrugated steel pipe (CSP) storm drain and 12-inch oil pipeline (identified as ARCO). Underground Service Alert (USA) was contacted 48-hours prior to any excavation. The wells were installed to assess below grade conditions adjacent to the 8-in diameter railroad under drain pipe. The deeper wells were installed by an 18-in diameter auger, placing the pipe in the center and backfilling with angular ballast. The shallower wells were installed by hand excavating these areas, placing the pipe in the center and backfilling with ballast. Soils removed from this area were placed in Department of Transportation (DOT) approved 55-gal drums for eventual sampling and disposal. Periodically the oil on the water surface was manually removed with a vacuum truck during the dry season and oil and water will be removed with a vacuum truck during a rain event as needed. ACTA and Crimson is researching the possibility of installing a passive hydrocarbon skimmer system inside these wells (ACTA, January 2011).

2.3.2 Video Taping 8-inch Track French Drain System in the Texaco Slot Area

In the first and second week of January, National Plant Services (an EPA contractor) inspected a portion of the 8-in French drain system starting at the manholes located about 120-ft south of PCH and proceeding north in both the west and east side track drains. The inspection was performed by inserting a remote controlled robotic crawler camera into the drains and viewing the results on a monitor. The inspection was videotaped for future reference. The inspection of the west drain concluded at the cleanout located at Station 978+70 due to a blockage (Figure 4 of Project Plan) and in the east drain at Station 976+40 due to the loss of traction by the robotic crawler. The blockage on the west side drain appears to have been caused by ballast entering through a damaged cleanout into the track drain. The loss of traction on the east side drain was caused by a thick layer of oil in the bottom of the French drain system. ACTA proposed to continue the inspection of the French drain system starting at the same manholes located about 120 feet south of PCH (Station 983+30) and working south. National Plant Services was contracted to perform these activities. Additional inspections were performed at the following locations:

> Section A = West side proceeding north and south, between manholes at Station 983+30 and Station 999+00.
>
> Section B = East side proceeding north and south, between manholes at Station 983+30 and Station 999+00.
>
> Section C = West side proceeding north and south, between manholes at Station 999+00 and Station 1002+25,
>
> Section D = West side proceeding north and south, between manholes at Station 1002+25 and Station 1002+60,
>
> Section E = Proceed east and west, between manholes at Station 1002+60 (west side) and Station 1002+80 (east side),
>
> Section F = East side proceeding north and south, between manhole at Station 999+00 and where the track storm drain system tees into Segment E.

At the conclusion of the inspection activities, a report will be completed along with a copy of the videotape generated during the inspection activities and provided to the EPA. This report will document the location of any blockages, the presence of oil, and other significant findings (ACTA, February 2011).

2.3.3 Removal of Oil from City of Los Angeles Leeds Avenue Storm Drain System and Lift Station

The impacted storm water entered the City of Los Angeles' storm drain system on Leeds Avenue just north of the intersection with Opp Street and traveled south into the City's sump lift station located on I Street (Figure 5 of Project Plan). The impacted storm water was pumped through the City's sump lift station and was discharged into the Dominguez Channel south of the intersection of Leeds Ave and Southerland Ave.

ACTA assumed maintenance and operation (M&O) of Sump Lift Station No. 692 on January 21, 2011. The M&O activities included the drawdown of nuisance water that continually enters the pump station, the removal of any oily sheen on top of the water in the wet well, placement and maintenance of the boom in the Dominguez Channel, and coordination with the City of Los Angeles or their contractor during rain events.

As part of the emergency response plan for the sump lift station wet well and the storm drain system, ACTA mobilized personnel and equipment to the Site. ACTA personnel delineated and established safe working areas around the storm drain catch basins and manholes along Leeds Avenue to clean the storm drain Inlets and pipeline to remove oily water from the sump lift station including water from connector laterals near the Site. Confined space entries was utilized to clean the interior of the storm drain lines by pressure washing the interior drains leading from the Leeds Avenue catch basins to the sump lift station wet well. The sump lift station, wet wells, connector laterals and storm water drain lines were cleaned until the cleaning waters produced no oil sheen.

Sorbent material was utilized to collect free oil during the cleaning operations and removed at the completion of the cleaning operation. During cleaning operations, a vacuum truck or pump system was used to pump out impacted oily water. Approximately 100,000 gallons of impacted oily water was transferred into 21,000-gallon Baker tanks staged on-site.

At the completion of the work activity, the interior of the Baker tanks will be washed clean and the waste water disposed of in a similar manner (ACTA, February 2011).

2.3.4 Collection and Treatment of Storm Water

Fugitive oily product entered the railroad French drain system within the ACTA ROW in the area north of PCH and then migrated south until the oily waste was discharged into Leeds Avenue near the intersection with Grant Street. The oily runoff flowed south and then entered the City of Los Angeles' storm drain system on Leeds Avenue just north of the intersection with Opp Street. The oily waste traveled south from the intersection into the City's sump lift station located on I Street. The City's sump lift station then discharged the oily water into the Dominguez Channel.

As part of the emergency response action EPA installed a storm water collection and treatment system near the intersection of Leeds Avenue and Grant Street. The collection and treatment system was located south of the 18-inch outfall from the French drain system. The collection and treatment system was designed as a "polishing area" prior to discharging storm water into Leeds Avenue curb and system.

During the emergency response action ACTA mobilized personnel and equipment to intersections of Leeds Ave. and Grant Street to install a larger collection and treatment system. The area of the collection and treatment was spray painted prior to placement of materials.

ACTA improved and enlarged the existing collection and treatment system by placing Temporary Railings (Type K), also known as K-Rails, along the east and west curb (in the gutter) of Leeds Avenue, and across both ends. A V-ditch was used to transport the storm water from the southern end of the 18-inch corrugated steel pipe (CSP) at the northwest corner of Leeds Avenue and Grant Street to the collection and treatment system.

After placement of the K-Rails, the area was lined with 10-mil plastic sheeting, including covering the sidewalls of the K-Rails. The plastic sheeting (rolls of 20 feet by 100 feet) was overlapped by approximately 2 feet with the southern section placed under the northern section. Sandbags were placed along the overlapped area to create a seal. Sandbags were also used to anchor the plastic along the bottom of the K-Rails on the inside and outside of the collection and treatment area.

Three weir areas were constructed in the same manner equal distant along the length of the detention area except the plastic sheeting extends up and over each row of K-Rails. Sandbags were placed at the east and west ends of the K-Rails where the weirs were installed.

The weir system contains PVC pipes with valves which will allow the movement of water between each weir area. As the flow of water fills up each weir area, the water will slow down allowing the oil to float to the top where it can be removed with pads and booms prior to being released into the next downstream weir area.

ACTA estimated the volume of the water in the collection and treatment system as approximately 170,000-gals assuming an average depth of 2-ft. Treated water will be discharged to the City of Los Angeles storm drain (ACTA, February 2011).

Crimson intends to take over operation of the containment and collection facilities and ongoing response activities at the Shell Lube Plant and at the Collection Area as described above. The takeover by Crimson will occur as soon as Crimson enters into access agreements with the property owners of those facilities. Crimson will coordinate the transition with ACTA and their contactors.

Based on previous investigations of crude oil spill, the general constituents of potential concern (COPC) consist of Total Extractable Petroleum Hydrocarbon (TEPH), Volatile Organic Compounds (VOCs), and Semi Volatile Organic Compounds (SVOCs). The actual COPC will be identified based on laboratory data provided by the EPA, ACTA and Crimson.

2.4 GEOLOGICAL AND HYDROGEOLOGY INFORMATION

2.4.1 Regional Geology

The dominant structural features in the Long Beach area are the Newport-Inglewood Structural Zone (NISZ) and the Palos Verdes (PV) fault zone. The NISZ is expressed approximately 3 miles northeast of the Site by a chain of elongated low hills and fault scarps caused by northwest-trending, left-stepping, en echelon faulting (Randell et. al., 1983). The PV fault zone is located approximately 3 miles southwest of the Site and is responsible for structural uplift of the Palos Verdes Hills. In the Site vicinity, the major deep subsurface feature of significance is the Wilmington anticline. This feature is a mid-Pliocene-age, linear structure that extends southwest from Redondo Beach through the Wilmington District of Los Angeles and ultimately through the Long Beach Harbor. The Site is located on the southern flank of the Wilmington Anticline and the underlying stratigraphic units dip toward the southwest as shown in California Department of Water Resources (CDWR) Bulletin 104 (Shell 2008). The area is within the Wilimington Field oil production operating area, which has had a long history of continuous drilling, production, and transportation of crude oil for close to 90 years.

The stratigraphy of the Basin consists of approximately 14,000 feet of Miocene to Recent marine and continental sediments, overlying a pre-Miocene basement complex. The upper 500 to 700 feet of the stratigraphic column is composed, with decreasing depth, of the San Pedro Formation, Lakewood Formation, Holocene (Recent) sediments, and man-made fill. The Recent sediments consist of two recognized units: upper finer-grained deposits and lower coarser-grained deposits (CDWR, 1961).

2.4.2 Regional Hydrogeology

Unconsolidated surficial deposits are underlain by the Bellflower aquiclude, which is 40 to 60 feet thick in the vicinity of the Site. Shallow groundwater may exist in water-bearing units of the Bellflower. Four major aquifers have been reported in the southern portion of the West Coast Basin in the vicinity of the Site. They are, with increasing depth: the Gaspur aquifer, the Gage aquifer, the Lynwood aquifer, and the Silverado aquifer (CDWR, 1961).

The Gaspur aquifer is comprised of coarse-grained lower Recent deposits. In the vicinity of the Site, the western extent of the Gaspur has been interpreted by others (Equilon, 2001; Texaco Environmental Services (TES), 1992) to pinch out beneath the LAR facility and apparently does not extend under the Site. Transmissive Gaspur gravels (or gravelly sands), where present, beginning about 70 to 90 feet bgs and are about 40 to 60 feet thick in the area of the LAR. The Gage aquifer, located below the Bellflower Aquiclude at the Site, collectively comprises up to four sand zones located within the basal Lakewood Formation. These sand zones are thin discontinuous aquifer units separated by thin, fine-grained layers. The lower unit contains the coarsest material and is the most extensive. The Gage aquifer is 40 to 60 feet thick and extends to a depth of 150 to 200 feet bgs. From approximately Willow Street southward through the Site vicinity and to Long Beach Harbor, the principal member of the Gaspur aquifer is in hydraulic connection with the underlying Gage aquifer. The Lynwood aquifer and deeper Silverado aquifer are located within the San Pedro Formation. The Lynwood is relatively uniform in thickness, ranging from 150 to 200 feet thick and extends 275 to 350 feet below mean sea level (msl). It is dominated by coarse sand and gravel in the Site vicinity (Equilon, 2001). The Silverado aquifer is of variable depth due to structural movements. It is approximately 350 feet thick and is located between 350 and 950 feet bgs in the Site vicinity. These two aquifers, Lynwood and Silverado, are the major sources of groundwater for municipal drinking water wells in the Los Angeles Basin (Equilon, 2001). The Silverado aquifer is believed to be in direct contact with the Lynwood in the vicinity of the intersection of Avalon Boulevard and Sepulveda Avenue (RETEC, 2005).

A significant man-made hydrogeological feature in the Site vicinity is the Dominguez Gap fresh water injection barrier. Excessive historic pumping of the Gage, Lynwood, Silverado, and Sunnyside aquifers north of the Site caused intrusion of salt water inland from the Pacific Ocean which degraded groundwater quality and threatened future drinking and production water use of these aquifers. This situation is being mitigated by injecting fresh water into these aquifers via the Dominguez Gap injection wells to create a fresh water hydrologic barrier between the Pacific Ocean to the south and drinking water supply wells to the north. The Site is located on the inland side of the Dominguez Gap barrier. The injection programs have been in operation since 1970 (Randell et. al., 1983) and have resulted in a regional water level rise of more than 30 feet during the past 30+ years.

2.4.3 Site Geology

Subsurface investigations conducted by URS and others at the Shell Lubes Plant have concluded that the top three to twelve feet of soil on-site generally consists of fill. The fill material consists of silty to clayey, very fine-grained sands with some debris. Underlying the fill material are thickly interbedded, laterally discontinuous sands and silty sands, which extend 20 to 30 feet bgs. Sands in this interval are very fine grained. Bivalve fragments are abundant in isolated layers (Shell, 2008).

2.4.4 Regional Groundwater

Groundwater in the Silverado, Lynwood, and Gaspur/Gage aquifers underlying the Site generally flows toward the east-northeast, south-southwest, and northwest, respectively. Horizontal groundwater gradients range from 0.002 to 0.003 feet per foot (ft/ft) in the Silverado, 0.001 to 0.003 ft/ft in the Lynwood, 0.003 to 0.06 ft/ft in the Gaspur/Gage aquifer. Calculated horizontal groundwater-flow velocities range from 1 to 2 feet per day in the Silverado, 0.006 to 2 feet per day in the Lynwood, and 0.1 to 74 feet per day in the Gaspur/Gage aquifer. In general, vertical groundwater gradients are downward between adjacent aquifers in the area (Equilon, 2001). The northwesterly groundwater flow direction observed at the Site may be the result of Dominguez Gap Barrier Project injection wells interfering with the regional southerly gradient (Trihydro, 2003).

Aquifers in West Coast Basin have extremely variable transmissivity. The Silverado aquifer has the highest transmissivity rate, averaging about 150,000 gallons per day per foot (gpd/ft) of width up to a maximum of about 400,000 gpd/ft near Torrance and near the intersection of Alameda and Sepulveda Boulevards. The other aquifers generally have lower transmissivity rates since they are thinner and have smaller grain sizes. The Gaspur, Gage, and Gardena aquifers have transmissivity rates of about 50,000 to 100,000 gpd/ft, in West Coast Basin. In general, transmissibility rates near the ocean are lower than they are in the center of the basin. Although the combined transmissivity rates of all aquifers are low along some parts of the Newport-Inglewood uplift, they are relatively high in other portions, particularly in the Dominguez Gap (CDWR, 1961).

2.4.5 Site Groundwater

A report on the Shell Lubes Plant provided information on the local groundwater hydrology. The following description is provided from that report.

A total of 34 groundwater monitoring wells are located on and adjacent to the Shell Lubes Plant and are included in the quarterly groundwater monitoring program. All of these wells are screened in the first encountered groundwater unit. On-site measured groundwater elevations ranged from approximately 1 to 8 feet below msl at the Shell Lubes Plant. Depth to groundwater ranged from approximately 22 to 38 feet below ground surface (bgs). On-site uppermost groundwater flow direction is consistently to the north-northwest at an average gradient of approximately 0.007 ft/ft (Shell, 2008).

2.5 ENVIRONMENTAL AND/OR HUMAN IMPACT

The extent of impact to the environment is unknown at this time and is under investigation.

3.0 PROJECT DATA QUALITY OBJECTIVES

This section of the SAP describes the procedures by which the accuracy and validity of sample data generated during the assessment, remediation and post remediation sampling and analysis of soil and surface water will be maintained. The following subsections describe the project task and problem definition, DQs, DQLs, data review and validation, data management, and assessment oversight associated with this project.

3.1 PROJECT TASK AND PROBLEM DEFINITION

The purpose of this SAP is to provide guidance for soils and surface water sampling and analysis in the Site area during the investigation, oil removal and post removal phases. These include the following:

1. *Prevent Oil Discharge*—Data will be collected to evaluate the limits of impacts resulting from the pipeline spill, and to mitigate further discharge from the Site.

2. *Source Removal*—Data collected during removal will be used to assess the efficacy and limits of removal actions, segregate impacted and clean media, beneficial reuse and/or recycling of the various affected media.

Post removal confirmation sampling and monitoring— To confirm the efficacy of removal activities data will be required at the completion of remediation operations.

3.2 DATA QUALITY OBJECTIVES (DQOS)

The data quality objectives for this project are to:

- Assess the limits of crude oil impact from the subject release to soil and surface water;

- Assess concentrations of COPCs at levels below applicable relevant and appropriate requirements (ARARs);

- Differentiate concentrations of COPCs above reference levels in soil and surface waters where reference concentrations may exceed applicable regulatory limits;

- Identify chemicals of concern from data collected during the investigation phase of removal actions; and

- Evaluate efficacy of removal actions through verification and confirmation sampling.

The precision, accuracy, representativeness, comparability, and completeness (DQIs) of the laboratory data will be assessed to determine the overall quality of the data. The QA objectives for precision, accuracy, and completeness of each measurement parameter are based on prior knowledge of the analytical method, the method validation studies (using replicates, standards, spikes, calibrations, recovery data), and the requirements of the specific project. Definitions of these parameters and the applicable quality control procedures are described below.

3.3 MEASUREMENT QUALITY OBJECTIVES (MQOS)

The data will be evaluated against the following parameters:

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability (precision) of two or more measurements compared to their average values. Precision is calculated from results of duplicate sample analyses. The duplicate samples will consist of one or more of the following: co-located samples, field blind replicates,
analytical laboratory replicate, and/or laboratory instrument replicate. Precision is quantitatively expressed as the relative percent difference (RPD), and is calculated as follows:

RPD = [(C1-C2)/(average of C1 and C2)] x 100

Where:

RPD = relative percent difference
C1 = larger of the two duplicate results
C2 = smaller of the two duplicate results

Laboratory duplicates will be analyzed at a frequency determined by the laboratory. Field duplicates will be collected at a rate of 5 percent and analyzed for site specific constituents of concern (COCs). The criteria for acceptable precision as determined by laboratory. All duplicate samples will be analyzed for site-specific COCs. Following collection of samples for VOC analysis, the soil samples will be homogenized and split in the field for analysis of nonvolatile or extractable constituents.

Accuracy is a measure of the closeness (bias) of the measured value to the true value. The accuracy of test results can be assessed by analyzing a reference material, third party performance evaluation samples, or "spiking" samples in the laboratory with known standards (surrogates or matrix spikes) and determining the percent recovery (%R). The frequency of matrix spike analysis will be determined by the laboratory. The acceptance criterion is specific for each analyte. The %R for the laboratory for each analyte is provided in laboratory QAM.

Representativeness is a qualitative measure of how closely the measured results reflect the actual concentration or distribution of the constituent concentrations in the matrix sampled. The sampling plan design, sampling collection techniques, sample handling protocols, sample analysis methods, and data review procedures have been developed to assure the results obtained are representative of on-site conditions at the time of sample collection.

Completeness is defined as the percentage of measurements judged to be valid. Results will be considered valid if they are not rejected during data validation. The target completeness goal for this work will be 90 percent for a given analysis.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard regulatory methods and procedures for both sample collection and laboratory analysis will make data collected comparable to both internal and other data generated.

Detection Limits or laboratory reporting limits are specified in the laboratory QA/QC documentation in the laboratory QAM. These limits must be sufficiently low to allow assessment of the data against the DQOs. Where these limits are raised due to matrix or chemical interferences, or elevated concentration, the dilution factor will be documented on the analytical report form.

Data Turn Around Time (TAT) is the time it takes the laboratory to return data to the decision makers from the time that the laboratory receives the data. In order to facilitate the decision making process in the field, the TAT used on this project will not exceed 5 days.

3.4 DATA REVIEW AND VALIDATION

The QA Manager, or his designee, will review the field and laboratory QA/QC data to determine whether the data meet the above DQO/DQI objectives. In the event that the criteria are not met, the impact to data quality will be evaluated and a determination will be made as to the need for resampling and/or reanalysis. Any data that falls outside the QA/QC criteria or cannot be validated will be flagged in the text and tables.

3.5 DATA MANAGEMENT

Data management will entail the following to ensure accurate transfer of data from collection to analysis:

- Use of standardized forms that include field notes, field data sheets, chain-of-custody forms, and sample labels;
- Proof reading of notes and data as a check against transportation errors;
- Review of field notes and data by the QA Manager for completeness and consistency;
- Review of analytical data by the QA Manager as indicated in Section 3.4 above; and
- Review of final report by the Project Manager.

3.6 ASSESSMENT OVERSIGHT

A field audit may be conducted to verify that sampling is performed in accordance with the procedures established herein. A performance and system audit of the laboratory may be conducted to verify analyses are completed as identified in the laboratory's Quality Assurance Manual (QAM). The audits of field and laboratory activities may include two independent parts: internal and external audits.

3.6.1 Field Performance and System Audits

3.6.1.1 Internal Field Audits

Internal audits of field activities, including sampling and field measurements, can be conducted prior to, at the start of, or at any time during field sampling activities by the Quality Assurance Officer (QAO) or the QAO's assigned designee. These audits will verify that all established procedures are being followed. The audit will be completed at the beginning of the project and will include a review of all field activities completed at that time.

Internal field audits will be conducted at least once at the beginning of the site sample collection activities. If warranted, additional field audits may be completed.

The audits will include but not be limited to examination of the following:

- Field sampling records;
- Field screening analytical results;
- Field instrument operating records, sample collection handling and packaging in compliance with the established procedures;
- Maintenance of QA procedures; and
- CoC procedures.

Follow-up audits may be required to correct deficiencies and to verify that QA procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The QAO will issue an audit report to the Project Consultant. Non-conformances will be addressed and resolved by the Project Consultant.

3.6.1.2 External Field Audits

If performed, external field audits may be conducted prior to, at the start of, or at any time during field sampling activities. External field audits may be conducted any time during the field operations. These audits may or may not be announced.

External field audits will be conducted according to the field activity information presented in this SAP and the accompanying SOPs (Attachment A). The QAO will issue an audit report to the Project Consultant. Non-conformances will be addressed and resolved by the Project Consultant.

3.6.1.3 Performance and System Audits

Performance and system audits may be conducted to verify documentation and implementation of the QA program, assess the effectiveness of the work plan, identify any non-conformances and verify corrective action of identified deficiencies. Repeated failure or gross irregularities in field duplicate, QA split, and/or calibration or quality control samples may warrant the need for an audit.

Performance Audits

Performance audits are used to quantitatively assess the accuracy of measurement data through the use of performance evaluation and blind check samples. The performance audit, if needed, will be performed by the QAO or QAO's assigned designee in accordance with documented procedures. Performance audits of the laboratory are performed in accordance with the procedures and frequencies established for SW-846 and SDWA methodologies. The QAO will evaluate the need for additional performance audits with due consideration given to the recommendations of the Project Consultant.

System Audits

The QAO may conduct a system audit of the fieldwork performance. The Investigation Coordinator (IC) is responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of work is adequate and complete. The IC is responsible for overseeing that the project field team follows the field procedures set forth in the SOPs. Reports and technical correspondence will be peer reviewed by an assigned qualified individual, otherwise external to the project, before being finalized.

Audit Records

If an audit is completed, the original records generated for all audits will be retained within the central project files. Records will include audit reports, written replies, the record of completion of corrective actions and documents associated with the conduct of audits, which support audit findings and corrective actions as appropriate.

3.6.2 Laboratory Performance and Systems Audits

3.6.2.1 Internal Laboratory Audits

Internal Laboratory Audit Responsibilities

If performed during this project, the QAO will conduct the internal laboratory audit prior to, at the start of, or at any time during field sampling activities.

Internal Laboratory Audit Frequency

If performed, the internal system audits and internal performance audits will be conducted on an annual basis.

Internal Laboratory Audit Procedures

If performed, the internal system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, CoC procedures, sample preparation and analysis, instrument operating records, etc. The performance audits will involve preparing blind QC samples and submitting them, along with project samples, to the laboratory for analysis throughout the project. The QAO will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. If the laboratory fails the QC sample analysis, they will be given another opportunity for blind QC sample analysis. A second failure will be cause for termination of the laboratory from the project.

3.6.2.2 External Laboratory Audits

External Laboratory Audit Responsibilities

An external audit may be conducted, as required, by the QAO or QAO's assigned designee.

External Laboratory Audit Frequency

If performed, the external audit will be conducted prior to, during, or after sampling and analysis activities. These audits may or may not be announced. Repeated failure or gross irregularities in the field duplicate, QA split, and calibration or quality control samples may warrant the need for an audit.

Overview of the External Laboratory Audit Process

External audits may include review of laboratory analytical procedures, laboratory on-site visits and/or submission of performance evaluation samples to the laboratory for analysis. Non-conformances will be listed by the QAO or QAO's assigned designee and a report will be issued to the PC and the laboratory. The laboratory will be given a week to address the non-conformances to the satisfaction of the QAO or QAO's assigned designee and the PC. Failure to resolve any or all audit procedures chosen can lead to laboratory disqualification and the requirement that another suitable laboratory be chosen.

An external on-site review can consist of sample receipt procedures, custody, sample security and log in procedures, sample throughput tracking procedure, review of instrument calibration records, instrument logs and statistics (number and type), review of QA procedures, logbooks, sample prep procedures, sample analytical SOP review, instrument (normal or extends quantitation report) reviews, personnel interviews, review of deadlines and glassware prep and a close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include, but not be limited to, the following:

- Comparison of resulting data to the SOP or method, including coding for deviations;
- Verification of initial and continuing calibrations within control limits;
- Verification of surrogate recoveries and instrument timing results, where applicable;
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable;

- Recoveries on control standard runs;

- Review of run logs with run times, ensuring proper order of runs;

- Review of spike recoveries/QC sample data;

- Review of suspected manually integrated GC/MS data and its cause (where applicable);

- Review of GC/MS peak resolution for isolated compounds as compared to reference spectra (where applicable); and

- Assurance that samples are run within holding times.

An external audit may initiate within the laboratory to review procedures and verify the list above. Data packages may be requested either in hard copy or electronic form to be reviewed on or off the laboratory premises.

3.6.3 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective action proposed and implemented will be documented in regular QA reports to management. Corrective action will only be implemented after approval by the PC or PC's assigned designee.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the PC, who in turn will notify the OSC. If the problem is analytical in nature, information on these problems will be promptly communicated to the QAO.

Any non-conformance with respect to the established QC procedures in this SAP will be identified and corrected in accordance with the SAP. The PC or PC's assigned designee will issue a non-conformance report for each non-conformance condition.

3.6.3.1 Field Corrective Action

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the SAP, etc.) or if sampling and/or field analytical procedures require modification due to unexpected conditions. In general, the IC or QAO may identify the need for corrective action. The field staff, in consultation with the IC will recommend a corrective action. The Project Consultant will approve the corrective measure (after consultation with and concurrence by the PC and OSC) that will be implemented by the field team. It will be the responsibility of the IC to ensure the corrective action has been implemented. All corrective actions implemented will be documented in the field logbooks.

3.6.3.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions (such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples, etc.) may be identified during sample login or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the laboratory Quality Manager to approve the implementation of corrective action. Depending on the condition encountered, the laboratory Quality Manager may consult the QAO for input. Conditions during or after analysis that may automatically trigger corrective action or optional procedures include dilution of samples, additional sample extract cleanup, automatic re-injection/re-analysis when certain QC criteria are not met, etc. A summary of method-specific corrective actions is available in the laboratory QAM. All laboratory corrective actions will be documented and also identified in the case narrative of the data packages.

3.6.3.3 Corrective Action during Data Review, Verification and Validation

The need for corrective action may be required during the data review, verification or validation. Potential types of corrective action may include re-sampling by the field team or re-extraction/re-analysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team and if the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded). If a corrective action is identified, it is the PC or PC's assigned designee who will be responsible for approving the implementation of corrective action, including re-sampling, during data assessment. All corrective actions of this type will be documented in the project file.

3.6.4 Quality Assurance Reports to Management

The Project Consultant will report to the PC regularly regarding progress of the fieldwork and quality control issues associated with field activities.

The laboratory maintains detailed procedures for laboratory recordkeeping in order to support the validity of all analytical work. Each data set report submitted to the QAO will contain the laboratory's written certification that the requested analytical methods were run and that all QA/QC checks were within established control limits for all samples analyzed.

After receipt of all analytical data, the Project Consultant or his designee will submit a Data Review Report for each data set to the QAO describing the accuracy and precision of the data. Verbal reports will be provided following the receipts of individual packages as they are received.

After the fieldwork is complete and the final analyses are completed, reviewed, and validated, a final report will be prepared. The report will summarize the QA and audit information (if completed), indicating any corrective actions taken and the overall results of SAP compliance. The IC or IC's assigned designee will prepare this final summary and submit this to the QAO for review. The report will be utilized during the decision-making process and will be incorporated as part of the final report.

4.0 SAMPLING RATIONALE

Detectable COPC concentrations may exist at the Site as a result of other sources unrelated to the Dominguez Spill. Investigation soil samples directly related to the Dominguez Spill will be compared to crude oil samples from the THUMS and Youngstown pipelines. These investigational and crude oil samples will be used to identify the COPCs actually related to the Dominguez Spill. Soil contamination unrelated to the Dominguez Spill will not be investigated by Crimson.

Crimson will collect and analyze crude oil samples from the Youngstown production which is transported in the Youngstown Lateral pipeline and crude oil from the THUMS 8-inch pipeline. As these oils are cited by the EPA as possible sources of oil in the release, the hydrocarbon "fingerprint" analysis will be used to identify "marker" sources by which comparison will be made.

Soil and water samples will be collected for the purpose of evaluating the limits of crude oil impact, to assess the efficacy of removal operations and to evaluate waste materials for disposal or reuse/recycling, as appropriate.

Investigation sampling will generally be biased high to identify the limits of impact and worst-case conditions, while confirmation and waste characterization samples will be collected randomly and based on statistical testing. The sampling rationale presented herein has as its basic goal the intent of identifying COCs, characterizing areas of concern (AOCs) within the Site where COCs exceed removal goals, and evaluating residual concentrations at the completion of removal activities.

As identified in the Project Plan, general COPCs consist of TEPH, VOCs, and SVOCs. Actual VOC and SVOC analytes of concern will be determined in the investigation phase. To determine which COPCs will be carried forward as COCs, data collected during investigation will be compared to reference concentrations and removal goals. In addition, statistical evaluations will be performed using the methods set forth in EPA SW-846 to evaluate whether a specific COC may be used as a surrogate for cleanup and confirmation of other analytes. Experience has shown at many crude oil sites that TEPH may be used as a surrogate for cleanup for VOCs and SVOCs. The surrogate COC will be selected based on statistical analysis of investigation data. Although a surrogate may be selected to guide removal actions, 10 percent of final confirmation samples will be analyzed for all COCs.

In soil, TEPH will likely be used as the primary surrogate for evaluating removal activities, with secondary criteria based on concentrations of monoaromatics (benzene, toluene, ethylbenzene and total xylenes) and polycyclic aromatic hydrocarbons (PAHs). The removal criteria for TEPH, VOC, SVOCs and monoaromatics are from the regional screening levels (RSLs) published by the EPA Regional IX.

Contaminated soil will be removed when removal does not jeopardize the structural integrity of building, roadways, ACTA railroads, utilities or other assets. The operational goal is the removal of all "free oil" (phase-separated oil) and soil impacted above the Site's removal goals. The Site removal goal values represented in the Project Plan are for contaminants related to the industrial soil. The proposed quantitative removal goal for TEPH will be 10,000 milligrams per kilogram (mg/kg) in soil. Until such time as TEPH can be established as the surrogate COC for removal activities, the following preliminary removal goals will be used at the Site for aromatics and naphthalene, based on the EPA Region IX RSL.

Benzene	5.4 mg/kg
Toluene	45,000 mg/kg
Total Xylenes	2,700 mg/kg.
Naphthalene	18 mg/kg

Quantification and reporting of TEPH will be full carbon chain ranges of <C12, C13 to C22 and C23 to C44.

Investigation and confirmation sampling and analysis will allow data evaluation consistent with these goals and action levels.

4.1 SOIL SAMPLING

Soil samples will be collected from safely accessible areas of the railroad right-of-way, the French drain system, and from the areas adjacent to railroad ROW and pipeline. Soil samples will be collected from the French drain system using manual sampling methods that will include spades and hand augers as detailed in SOP ERPA-001 and equipment will be decontaminated according to SOP ERPA-002. Additional soil samples may be collected from the railroad ROW and French drain system using other suitable methods. Samples collected for VOC analysis will collected in accordance with EPA method 5035. Soil sample locations will be determined based on visual evidence of gravel impact and previous knowledge of subsurface impact.

The exact locations of soil borings will be determined during the investigation phase and upon review of the video tape from the 8-inch track storm drain system. The sampling locations described in this SAP may be changed based on encountered field conditions. The following locations along the spill area will be investigated:

Youngstown Lateral Pipeline—as part of the incident investigation, approximately 90 feet of pipeline will be removed in sections of undetermined length dependent upon access provided by the adjacent property owners. Soil excavation and shoring will be required at both ends of the Youngstown Lateral as part of the pipeline removal (Figure 3 of Project Plan). Any impacted soil will be removed from the excavation and disposed of offsite as part of the source removal. Soil samples at each end of the removed pipeline will be advanced to confirm the vertical and lateral limits of impact surrounding the damaged casing. Soil samples will be collected where safely accessible as described below.

- Where visually impacted by crude oil, soil samples will be collected from the sidewalls and bottom of the excavation once the visually impacted soil has been removed. Photo documentation and reference point will be used to identify the location of visual free oil.
- Based on safety concerns, soil samples within the excavation may be collected directly from the bucket of the excavation equipment. One soil sample approximately every 10 linear feet will be collected from the centerline of the excavation.

- One soil samples every 10 linear feet of the perimeter edge will be collected from the sidewall of the excavation.
- Bottom soil samples will be collect 0.5 feet and 3 feet below the visual extent of impact from the excavation (if impact is evident, deeper samples will be attempted).
- Sidewall samples will be collected 0.5 feet and 3 feet beyond the visual extent of impact from the excavation sidewall (if impact is evident, deeper samples will be attempted).
- Sample locations and depths may be modified and will be determined by encountered field conditions.
- If the bottom or sidewall of the excavation consists of exposed ballast material or gravel, no sample will be collected and a visual assessment will be conducted to ascertain the need for removal based on evidence of free oil.
- All visually impacted soil will be removed to the limit of excavation necessary to install the engineered shoring unless liquid free oil is identified. If free oil is present, the excavation equipment may be used to remove all accessible soil to practical lateral and vertical extent.
- Due to the safety concern associated with the ROW, there exists the possibility that some impacted soil may not be removed or sampled. Approval from EPA and ACTA to leave impacted soil in-situ may be requested based on the location of the soil.

Shell Lubes Plant – The Shell Lubes Plant property is primarily asphalt pavement (Figure 2 of Project Plan). Confirmation with the Shell Lubes Plant has determined that the asphalt surface pavement has been cleaned and is free of any oil. Investigation soil boring in non-asphalt areas will occur if there are indications of impact from crude oil. A Work Activity Plan and recommendations for any future work required in this portion of the project will be provided to EPA upon completion of investigation.

Soil samples will be collected from safely accessible areas of the Shell Lubes Plant that present evidence of crude oil contamination. All boring or other sampling locations must be approved in advance of sampling activities by Shell. Soil samples will be collected from the Shell Lubes Plant with a Geoprobe direct push type rig or using manual sampling methods that will include spades and hand augers.

Soil sample locations will be determined based on visual evidence of surface impact and previous knowledge of subsurface impact.

- Borings transects will be placed in non-asphalt areas along the flow line of the oil at intervals of approximately 25 feet where safely accessible.
- The center borings within each transect will be placed at the lowest elevation. Step-out borings along each transect will be spaced at approximately 25 feet intervals where visual impact is present.
- Soil samples will be collected at depths of 1 foot and 5 feet beyond the visual extent of impact from the boring. If impact is evident, deeper samples will be attempted.
- Due to the safety concern associated with the ROW, some impacted soil may not be removed or sampled. Approval from EPA, Shell, and ACTA to leave impacted soil in-situ may be requested based on the location of the impacted area.

Subsurface soil conditions will be continuously logged and samples will be collected to confirm the vertical and lateral limits of impact. At least two soil samples will be collected for analyses: one within the contaminated portion of the soil column and one below the visually evident impacts to assess the limits of impact.

French drain system— Areas where blockages of the French drain system were reported in the video tape provided by ACTA will be given priority for inspection by Crimson as part of the free oil recovery (Figure 4 of Project Plan). Impacted ballast material and gravel will be removed as part of the oil removal and investigation. The exact number and locations of blockages along the French drain will be determined from information and video data provided by ACTA. Soil samples along the western and eastern side of the French drain system adjacent to the railroad track will be collected to confirm the vertical limits of impact surrounding the blockage area. Soil samples will be collected as described below only where safely accessible.

- Soil samples will be collected adjacent to the existing French drain and/or utility piping.
- One investigational soil boring will be advanced every 20 feet from the bottom of the French drain system where impact is evident in the subgrade.
- One investigational soil boring will be advanced where known utility laterals intersect the French drain system.
- Soil samples will be collected from 0.5 foot and 2.0 feet at each boring location. If impacts are evident, deeper samples will be attempted.
- Sample locations and depths may be modified and will ultimately be determined by encountered field conditions.
- Where the bottom of the French Drain consists of exposed concrete or cemented ballast larger than 2 inches in diameter, no sample will be collected and a visual assessment will be conducted to ascertain the need for removal based on evidence of free oil.

Due to the safety concern associated with work in the railroad ROW, some impacted soil may not be removed or sampled. Approval from EPA and ACTA to leave impacted soil in-situ may be requested based on the location of the soil.

Depending on the results of the crude oil sample analyses, investigation samples may be analyzed for one or more of the following:

TEPH-full carbon chain	EPA method 8015B
VOCs	EPA method 8260B
SVOCs, including PAHs	EPA method 8270C
CA Title 22 Metals	EPA method 6010B

VOC and SVOC analyses will be selected based on positive TEPH results. No sample will be analyzed for VOCs and SVOCs where TEPH is not detected above laboratory reporting limits. Samples exhibiting higher concentrations of TEPHs will generally be analyzed for VOCs and SVOCs by EPA method 8260B and 8270C, respectively. Soil samples exhibiting higher concentrations of TEPH will generally be analyzed for metals by EPA method 6010B. This soil analysis selection plan will be followed until COC's are confirmed to be below action levels. Approval from the Unified Command will be requested prior to eliminating analyses that are approved in this SAP.

4.2 SEDIMENT SAMPLING

Not Applicable

4.3 SURFACE WATER SAMPLING

It is not anticipated that sampling of surface waters from the Dominguez Channel will be required. However, should it be determined by the Unified Command, that surface water sampling is necessary, surface water samples may be collected from the Dominguez Channel using a weighted clean sample jar or sample dipper in accordance with SOP ERPA-010. In most cases these jars will be the actual sample jar, with the exception of sample containers containing preservative. For these samples, water contained in a sample jar or sample dipper will be carefully decanted into glass VOAs to minimize turbulence or bottles for preservation and delivery to the laboratory as indicated in subsequent sections.

4.4 OTHER SAMPLING (INVESTIGATION SAMPLES)

The objective of investigation as previously stated is to assist in the identification of COCs, identify AOCs, evaluate the extent of impacts in soil and surface water to the degree possible, and to facilitate the selection of removal actions.

During investigation, much of the assessment will be based on visual evidence of oil within the ballast, French drain fabric and gravel pack and entrained in the soil matrix, field PID measurements for VOCs, as well as laboratory sample analyses. Investigation samples will be collected for field assessment and laboratory analyses with the focus on evaluating COPCs and identifying vertical and lateral extent of AOCs where removal action is required.

To assess COPCs, as previously discussed, a sample of fresh crude oil from the THUMS pipeline, Youngstown pipeline, and a sample of weathered crude oil from the spill area will be collected and analyzed for the following constituents:

Total Extractable Petroleum Hydrocarbons (TEPH-carbon chain)	EPA method 8015B
Volatile Organic Compounds (VOCs)	EPA method 8260B
Semi-VOCs (SVOCs), including PAHs	EPA method 8270C
CA Title 22 Metals	EPA method 6010B

The results of the fresh crude oil and weathered oil will be compared, reported on, and submitted under one cover. This investigation data will be used to assess COCs (other than TEPH) for removal action. Any analyte exhibiting concentrations above cleanup goals will be added to the COC list for characterization. At this point, COPCs are expected to consist of at least TEPH and BTEX.

The following decisions will be used to guide investigation:

- If liquid oil is encountered, then the area will be designated for removal action of visible oil and free oil entrained in soil.
- Investigation will be guided largely by visual observation and PID readings.
- The quantification and identification of COCs will be determined by collecting a few samples from the Youngstown Lateral, Shell Lube Plant, and/or French drain area. The number of samples collected will be determined in the field and will be based on available video tape information, visual evidence of oil in the ballast material, etc.
- If reported COPC concentrations exceed the removal goal in the deepest or perimeter samples collected at each location, additional step out or deeper samples may be collected to determine the extent of impact. A determination will be made in the field, as to the feasibility and necessity of step out and deeper sampling.

The sample locations will be determined in the field at the time of investigation. All sample locations will be pre-approved by the EPA prior to sampling.

5.0 REQUEST FOR ANALYSES

TestAmerica Analytical Laboratories, Inc. (TestAmerica) and Zymax Forensic Laboratory (Zymax) has been selected as the primary analytical laboratory to analyze soil and water samples. A majority of the assessment samples will be submitted to TestAmerica. Quality Control including duplicates and splits samples will be submitted to both TestAmerica and Zymax.

With approval from the EPA, other laboratories may be used to quantify COPCs depending on the volume of samples generated and the capacity of the laboratory to analyze the samples within hold times or required expedited turn-around time (TAT) or for quality control and confirmation purposes.

5.1 ANALYSES NARRATIVE

Section 4 describes the analyses proposed for each matrix. These analyses will be conducted until such time that a specific anayte(s) are determined to no longer be chemicals of concern (COC). If a specific analyte is determined not to be a COC based on concentration or background study, a petition will be submitted to the unified command requesting that the analyte no longer be part of the sampling program.

Sample analytical requirements are summarized in Tables 5.1 and 5.2 for soil and groundwater samples, respectively. Additional data validation and acceptance criteria, as well as proposed MDLs and RSLs for soil and groundwater are provided in Tables 5.3 and 5.4.

5.2 ANALYTICAL LABORATORY

Test America and Zymax are certified to perform the analyses indicated herein by the California Environmental Laboratory Accreditation Program (ELAP).

6.0 FIELD METHODS AND PROCEDURES

The following subsections provide guidance for field methods and procedures that include field equipment; sampling of surface water and soil; and decontamination. Additional detail is included in SOPS ERPA-001 (Soil Sampling); ERPA-002 (Decontamination Procedures); ERPA-010 (Surface Water Sampling); ERP-011 (Field Notebook); ERPA-302 (Variance/Time Delay Form); and ERPA-303 (Waste Management Form).

6.1 FIELD EQUIPMENT

The following provides a list of basic field equipment.

6.1.1 List of Equipment Needed

<u>Soil</u>
Hand auger (quick disconnect rods with 2 to 4 inch soil bailers)
Hand spades and shovels
Pick axe or pry bars 5-gallon buckets
Cleaning brushes
General health and safety equipment
Sample bottles (4 to 8 ounce glass)
Core samplers
Ice-chilled cooler
PID calibrated to (100 ppmv span gas)
Hand held GPS unit

<u>Water</u>
Sample jars or dippers
5-gallon buckets
General health and safety equipment
Sample bottleware (VOAs, amber glass bottles and plastic bottles)
Ice-chilled cooler
Water monitoring equipment
Hand held GPS Unit

Decontamination Supplies

6.1.2 Calibration of Field Equipment

Field instruments will be pre-calibrated with calibration performance checks performed on a daily basis. The field PID will be field calibrated to 100 ppm span gas on a daily basis in accordance with the manufacturer’s instructions.

The water monitoring equipment will be field calibrated on a daily basis, the dissolve oxygen (DO) and oxygenation reduction potential (ORP) meter will be calibrated using a standard solution prior to performing field measurements. The auto calibration mode of the DO meter calibrates the sensors to factory standards, the Zero value is adjusted at the factory before shipping.

Calibration and maintenance records for all field equipment will be kept and stored with the project field notes at the Beacon Energy office.

6.2 FIELD SCREENING

Not Applicable-Using PID already and no less accurate method.

6.3 SOIL

Exact soil sampling locations will be determined in the field based on accessibility, visible signs of potential contamination (e.g., stained soils), and topographical features which may indicate location of hazardous substance disposal (e.g., depressions that may indicate a historic excavation). Soil sample locations will be recorded in the field logbook as sampling is completed. A sketch of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to the reference points will be given.

Samples designated for VOC analysis will be collected first. All soil samples for VOC analysis will be collected in triplicate in accordance with EPA method 5035 (using EnCore samplers). Each EnCore Sampler will be collected from the sidewall of the boring/excavation, from the end of a core or tube sample, from the bottom of the hand auger bailer or from the bottom of the spade where the freshest sample is generally located. The EnCore Samplers will be collected in such a manner as to avoid contact with the hand auger or spade. A minimum of three EnCore Samplers will be collected from each sample point. The EnCore Samplers will be sealed with the provided caps, labeled, placed in labeled Ziploc bags and stored in an ice-chilled cooler for transport to the laboratory.

6.3.1 Surface Soil Sampling

Surface soil samples collected for lateral characterization of the extent of impact in soil will be sampled using a sampling trowel or equivalent methods (SOP ERPA – 001) to evaluate the lateral extent of crude oil impact. Surface soil samples that are to be collected within 6-12 inches of the ground surface. The sampling trowel will be used to collect the samples and then transfer samples to the appropriate containers. Soil samples will be selected for chemical analysis based on visual evidence of oil discoloration and availability of sufficient quantity to define the extent of impact in the subsurface.

Based on field observation of subsurface characteristics, samples will be collected at select intervals for measurement of headspace volatile organic vapors using a PID calibrated to 100 ppmv span gas. The following protocols will be followed in taking headspace measurements:

1. Seal sample in a labeled one quart resealable plastic bag (i.e.; Ziploc®).
2. Manually break up and homogenize the sample
3. Carefully open the corner of the bag and insert tip of the PID into the bag while taking care to seal the bag round the tip with finger tips.
4. Once the reading stabilizes (approximately 5 seconds), record the PID reading as ppmv.

All borings or sample points will be continuously sampled and logged.

Samples for analysis of nonvolatile components will be discharged directly from the bailer into 4 to 8 ounce jars and hand packed to remove dead air headspace and sealed with a Teflon-lined screw cap lid.

Excess set-aside soil from the above sampled interval will then be repacked into the hole.

6.3.2 Subsurface Soil Sampling

Subsurface soil samples will be collected for vertical characterization of the extent of impact in soil will be sampled using a hand auger, Geoprobe rig, or equivalent methods to evaluate the vertical extent of crude oil impact (SOP ERPA-001). Subsurface soil samples are generally those that are to be collected more than 12 inches below the ground surface, unless otherwise noted.

Continuous samples may be collected using a Geoprobe rig or other methods using samplers lined with 1.5- to 2-inch inside diameter clear acetate liners. The sample liner will be split longitudinally for characterization and logging. The entire length of the split core will be scanned with a PID. Samples will be collected for VOC and non-VOC analysis within portions of the core where impacts are evident and from "clean" portions above and below the impact zone to define the extent of impact. VOC samples will be collected using Core Samplers pushed directly into the core and sections of the core will be transferred to 4- to 8-ounce glass jars following the procedures outlined in this SAP.

Based on field observation of subsurface characteristics, samples will be collected at select intervals for measurement of headspace volatile organic vapors using a PID calibrated to 100 ppmv span gas. The following protocols will be followed in taking headspace measurements:

1. Seal sample in a labeled one quart resealable plastic bag (i.e. Ziploc®).
2. Manually break up and homogenize the sample
3. Carefully open the corner of the bag and insert tip of the PID into the bag while taking care to seal the bag round the tip with finger tips.
4. Once the reading stabilizes (approximately 5 seconds), record the PID reading as ppmv.

All borings or sample points will be continuously sampled and logged.
Samples for analysis of nonvolatile components will be discharged directly from the bailer into 4 to 8 ounce jars and hand packed to remove dead air headspace and sealed with a Teflon-lined screw cap lid.

Excess set-aside soil from the above sampled interval will then be repacked into the hole.

6.4 SEDIMENT SAMPLING

Not Applicable

6.5 WATER SAMPLING

6.5.1 Surface Water Sampling

If surface water samples are required, samples will be collected from the upper 0.5 feet of the channel using a weighted sample jar or dip. The jar or dip will be completely submerged to allow sampling below the air water interface. Where insufficient surface water exists in the wash, shallow wells will be excavated prior to sampling and the water will be allowed to clear before sampling. Where sufficient water exists, samples will be collected directly into the sample bottle, unless the bottle or VOA contains preservative. All bottles will be pre-preserved by the laboratory or supplier. For samples in preserved bottles or VOAs, the sample will be carefully decanted from a sampling jar or dipper directly into the sample bottle/VOA by carefully pouring the sample down the side of the sample jar (held at an angle) to reduce turbulence to prevent volatilization of any potential volatile fractions.

At each sampling location, all bottles designated for a specific analysis (e.g., VOCs) will be filled sequentially before bottles designated for the next analysis are filled (e.g., SVOCs). If a duplicate sample is to be collected at this location, all bottles designated for analysis for both sample designations will be filled sequentially before bottles for another analysis are filled. Where multiple bottles are required for a given set of analyses, duplicate samples will be collected from alternating filled bottles. For example, if 3 bottles are required for a given set of analyses and duplicate analyses are also scheduled (total of 6 bottles to be filled), bottles 1, 3 and 5 would be used as the original sample set and bottles 2, 4 and 6 would be used for duplicate analysis.

Water samples will be transferred from the discharge tube or outlet directly into the appropriate sample containers with preservative (if required), chilled, and processed for shipment to the laboratory. When transferring samples, care will be taken not to touch the lip or interior of the sample container to avoid artifact contamination.

Vials for VOC analysis (VOAs) will be filled first to minimize the effect of aeration on the water sample. The vials will be filled to prevent air bubbles and capped. The vial will be inverted and checked for air bubbles to ensure zero headspace. If a bubble greater than 6 mm in diameter appears in the VOA, the VOA will be discarded and a new sample will be collected in a fresh VOA.

Samples collected in amber glass bottles (two 500 ml bottles) for analysis of TEPH will also be preserved with HCl. All sample containers will supplied by the laboratory with the required perseverates. All samples will be stored in an ice-filled cooler for transport to the laboratory.

For additional detail see SOP ERPA-010.

6.5.2 Groundwater Sampling

Not Applicable

6.5.2.1 Water-Level Measurements

Not Applicable

6.5.2.2 Purging

Not Applicable

6.5.2.3 Well Sampling

Not Applicable

6.6 OTHER

Not Applicable

6.7 DECONTAMINATION PROCEDURES

The decontamination procedures that will be followed are in accordance with approved EPA procedures and SOP ERPA-002. Decontamination of sampling equipment must be conducted consistently as to assure the quality of samples collected. All equipment that comes into contact with the sample media will be decontaminated. Disposable equipment intended for one-time use will be packaged for appropriate disposal. Decontamination will occur prior to and after each use of a piece of equipment. All sampling devices used will be decontaminated according to the following general procedure:

Tap water and non-phosphate detergent wash using a brush or scrubber
Tap water rinse
Deionized/distilled water rinse

All cleaned materials shall be stored in manner to prevent contact with potentially contaminated media using plastic bags or by being placed upright in clean buckets or other containers. Materials to be stored more than a few hours will also be covered.

Decontamination fluids will be discharged to skim ponds or other approved areas where removal activities are ongoing.

7.0 SAMPLE CONTAINERS, PRESERVATION, PACKAGING AND SHIPPING

Proper sample container will be obtained from the laboratory prior to field operations. Sample containers used will be pre-cleaned and will not be rinsed prior to sample collection. Preservatives, if required, will be added by the laboratory or supplier prior to shipment to the field. The following subsections provide a discussion concerning containers, preservation, and storage for each type of analysis.

7.1 SOIL SAMPLES

For TEPH, soil samples will be contained in hand packed 4 to 8-ounce glass jars or 6-inch brass or stainless steel sample tubes. The top of the container will be struck off level to preclude headspace. Glass jars will be sealed with a Teflon-lined screw cap lid, while tube samples will be capped on each end with a Teflon sheet followed by tight-fitting plastic caps sealed with non-VOC tape. The sample will be preserved in an ice-chilled cooler at approximately 4°C.

Samples for VOCs will be collected in accordance with EPA method 5035. The sample will be contained in EnCore Sampler containers. A total of three EnCore Sampler containers will be collected at each sample point prior to agitation. Each Core Sampler will be sealed with the provided cap until it snaps into place. Each sample will be sealed in the resealable pouch, labeled and place in an ice-filled cooler at approximately 4°C. Frozen Encore sampler samples will be stored for no more than 4 days prior to analysis. If samples are preserved by ejecting into either methanol or sodium bisulfate solution the holding time is two weeks.

Soil samples will be contained in hand packed 4 to 8-ounce glass jars or 6-inch brass or stainless steel sample tubes. The top of the container will be struck off level to preclude headspace. Glass jars will be sealed with a Teflon-lined screw cap lid, while tube samples will be capped on each end with a Teflon sheet followed by tight-fitting plastic caps sealed with non-VOC tape. The sample will be preserved in an ice-filled cooler at approximately 4°C. The container used for TEPH analysis may also be used for SVOC analysis.

7.2 SEDIMENT SAMPLES

Not Applicable

7.3 WATER SAMPLES

Water samples for TEPH will be collected in 500 milliliter (mL) amber glass bottles pre-preserved by the laboratory with HCl (pH<2). Two bottles will be collected at each sample location. The bottles will be filled to allow the water to mound over the top of the bottle and then sealed with the screw cap lid to preclude any air bubbles or headspace. Once the bottles are sealed and labeled, the bottles will be stored in an ice-filled cooler for transport to the laboratory at approximately 4°C.

Water samples to be analyzed for VOCs will be collected in three 40 mL glass VOAs preserved by the laboratory with 1:1 HCl (pH<2). The vials will be filled to allow the water to mound over the top of the VOA and capped to remove any headspace. The samples will be stored in an ice-chilled cooler at approximately 4°C immediately following collection. Three VOAs will be required for analysis of VOCs from each water sample location.

Water samples for SVOC analysis will be contained in 1-liter amber bottles Supplied by the laboratory. Two bottles will be collected at each sample location. The bottles will be filled to allow the water to mound over the top of the bottle and then sealed with the screw cap lid to preclude any air bubbles or headspace. Once the bottles are sealed and labeled, the bottles will be stored in an ice-chilled cooler for transport to the laboratory at approximately 4°C.

7.4 OTHER SAMPLES

Not Applicable

7.5 PACKAGING AND SHIPPING

All sample containers will be placed in a strong-outside shipping container (a steel-belted cooler). The following outlines the packaging procedures that will be followed for low concentration samples:

1. When ice is used, pack it in zipper-locked, double plastic bags. Seal the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.
2. The bottom of the cooler should be lined with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.
4. Secure bottle/container tops with clear tape and custody seal all container tops.
5. Affix sample labels onto the containers with clear tape.
6. Wrap all glass sample containers in bubble wrap to prevent breakage.
7. Seal all sample containers in heavy duty plastic zipper-lock bags. Write the sample numbers on the outside of the plastic bags with indelible ink.
8. Place samples in a sturdy cooler(s) lined with a large plastic trash bag. Enclose the appropriate chain-of-custody forms in a zipper-lock plastic bag affixed to the underside of the cooler lid.
9. Fill empty space in the cooler with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment.
10. Ice used to cool samples will be double sealed in two zipper-lock plastic bags and placed on top and around the samples to chill them to the correct temperature.
11. Each ice chest will be securely taped shut with fiberglass strapping tape and custody seals will be affixed to the front, right and back of each cooler. Records will be maintained by the project sample custodian with the following information:
    - Name and location of the site or sampling area;
    - Total number(s) by estimated concentration and matrix of samples shipped;
    - Carrier, air bill number(s), method of shipment;

- Shipment date and when it should be received by lab;
- Irregularities or anticipated problems associated with the samples; and
- Whether additional samples will be shipped or if this is the last shipment.

8.0 DISPOSAL OF RESIDUAL MATERIALS

In the process of collecting environmental samples, several different types of potentially contaminated waste will be generated including:

- Used personal protective equipment (PPE);
- Disposable sampling equipment; and
- Decontamination fluids.

Waste Management Form ERPA-303 will be used to track the type, amount, location, and disposition of these various wastes.

8.1 USED PPE AND DISPOSABLE EQUIPMENT

Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

8.2 DECONTAMINATION FLUIDS

Decontamination fluids that will be generated in the sampling event will consist of deionized and tap water rinsate with dilute residual contaminants. The decontamination fluid will be properly disposed of at a local TSD facility.

9.0 SAMPLE DOCUMENTATION AND SHIPMENT

The following subsections provide details concerning sample documentation and shipping procedures including field notes, labeling, chain-of-custody, custody seals, and packaging and shipment.

9.1 FIELD NOTES AND LOGBOOKS

Because sampling situations vary widely, field notes will be as descriptive and inclusive as possible; such that anyone reading the entries should be able to reconstruct the sampling situation from the recorded information. Language within field notes will be objective, factual, and free of inappropriate or ambiguous terminology. All field personnel are to date and sign any data entries. All field documentation will be retained. Additional details on field notes can be found in SOP ERPA-011.

Sampling field data sheets include information on specific activities related to collection of a single sample. The sampling field data sheets will be completed in the field at the time of the sample collection by the sampling personnel. A Sampling Field Data Sheet is provided in Attachment B.

The field data recorded at the time of sample collection provides unambiguous identification of each sample. At a minimum, the following information will be recorded during the collection of each sample:

- Sample location (depth (in feet), description, and identified on maps);
- Site or sampling area sketch showing sample location and measured distances or GPS coordinates;
- Sampler's name;
- Date and time of sample collection;
- Designation of sample as composite or grab;
- Type of sample;
- Type of sampling equipment used;
- Field instrument readings and calibration;
- Field observations and details related to analysis or integrity of sample;
- Preliminary sample descriptions;
- Sample preservation; and
- Lot numbers of the sample containers, sample identification numbers and any explanatory codes, and chain-of-custody form numbers.

In addition to the sampling information, the following specific information will also be recorded in the field notes:

- Time of arrival/entry on site and time of site departure;
- Other personnel on site;
- Summary of any meetings or discussions with tribal, contractor, or federal agency personnel;
- Procedural deviations and/or personnel changes; and
- Calibration records.

9.2 PHOTOGRAPHS

Photographs will be taken at the sampling locations and at other areas of interest on the site or sampling area. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather; conditions;
- Description of the subject; photographed;
- Name of person taking photographs

9.3 LABELING

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique sample I.D. numbers. At a minimum, the sample labels will contain the following information in indelible ink: sample I.D., sample location, date of collection, analytical parameter(s), and method of preservation.

Each sample will be given a unique sample I.D. number for reference on maps, chain of custody documentation and field logs. The I.D. will designate whether the general location of the sample, the media sampled and a unique number identifying the sample location and depth. The nomenclature for each sample will be identified as follows:

ZV-XXY-ABB-CC

Where:

Z = Activity Phase
'N' for Investigation phase
'C' for confirmation phase

V = Duplicate sample
'V' for duplicate samples
Otherwise leave blank

X = General Location
'YL' for Youngstown Lateral
'FD' for French Drain
'SD' for Storm Drain Collection
'SL' for Shell Lubes Plant

Y = Media
'W' for water
'S' for soil

A = Sample Point Type
'T' for transect
'H' for hand auger
'G' for grab sample
'B' for boring sample

BB = Unique transect, or boring number (i.e. 01, 02….10, 11, etc.)

CC = Sample depth (i.e. 0.5, 2.5, 5.0 feet, etc.)

Trip blanks and equipment blanks will be labeled with the nomenclature of Z-XX-Y-AABBCC. Where:

Z = Activity Phase
'N' for investigation
'C' for confirmation

Y = Media
'W' for water or aqueous sample

AABBCC = Sample Date
'AA' = month, 'BB' = day, and 'CC' = year of sample collection

9.4 SAMPLE CHAIN-OF-CUSTODY FORMS AND CUSTODY SEALS

Chain-of-custody record forms are used to document sample collection and shipment to laboratories for analysis. All sample shipments for analyses will be accompanied by a chain-of-custody record. A copy of the form is found in Attachment C. Form(s) will be completed and sent with the samples for each shipment. If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the sampler. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number. The sample numbers for all Equipment blank samples, reference samples, laboratory QC samples, and duplicates will be documented on this form (see Section 10.0). A copy will be retained in the master files.

10.0 QUALITY CONTROL

The following subsections discuss collection and analysis of quality control samples including field quality control and laboratory quality control samples.

10.1 FIELD QUALITY CONTROL SAMPLES

Field quality control samples are intended to help evaluate conditions resulting from field activities and are intended to accomplish two primary goals: (1) assessment of field contamination (equipment blanks) and (2) assessment of sampling variability (duplicate samples). The former identifies substances introduced in the field due to environmental or sampling equipment and are assessed using blanks of different types. The latter includes variability due to sampling technique and instrument performance as well as variability possibly caused by the heterogeneity of the matrix being sampled and is assessed using replicate sample collection. The following sections cover field QC.

10.1.1 Assessment of Field Contamination (Blanks)

Not Applicable see below

Equipment Blanks

Equipment blanks will be collected in lieu of field blanks as they provide the best overall means of assessing contamination arising from the equipment, ambient conditions, sample containers, transit, and the laboratory. One equipment blank will be collected per day that sampling equipment is decontaminated in the field. Equipment blanks will be obtained by passing deionized water through or over the decontaminated sampling devices used that day. The Equipment blanks will be analyzed for VOCs, SVOCs, TEPH. The equipment rinsate blanks will be preserved, packaged, and sealed in the manner described for the environmental samples.

Field Blanks

Not Applicable

Trip Blanks

One travel or trip blank will be submitted for VOC analysis with each cooler containing sample requiring VOC analyses. Trip blanks are supplied by the laboratory with the sampling containers at the start of field activities and accompany the sample containers throughout the project.

Temperature Blanks

For each cooler that is shipped or transported to an analytical laboratory, a 40-mL VOA vial or pre-manufactured temperature blank will be included that is marked “temperature blank.” This blank will be used by the laboratory sample receiver to check the temperature of samples upon receipt.

10.1.2 Assessment of Field Variability (Field Duplicate or Co-located Samples)

Field duplicate samples will be collected from water, soil and sediment samples at a rate of 5 percent or one in 20 samples. VOC duplicates will be collected prior to agitation. Once the VOC samples are collected, the soil and sediment samples designated for field duplication will be thoroughly homogenized in a sealed plastic bag (VOCs) or in another clean container. The sample will then be split for duplicate sampling.

When collecting duplicate water samples, bottles with the two different sample identification numbers will alternate in the filling sequence. Note that bottles for one type of analysis will be filled before bottles for the next analysis are filled. Samples for volatiles will always be filled first.

Duplicate samples will be preserved, packaged, and sealed in the same manner as other samples of the same matrix. A separate sample number and station number will be assigned to each duplicate, and it will be submitted blind to the laboratory. Field duplicates will be identified in the field log book.

10.2 BACKGROUND SAMPLES

Background sampling may be required to evaluate the occurrence of constituents of concern in soil, groundwater and other media. The constituents of concern (i.e.; TPH, metals, VOCs and SVOCs) are known contaminants associated with urban activities and may be present as artifacts of regional background. For example, elevated metals, TPH and other contaminants are frequently encountered in railroad ballast. Similarly, runoff from industrial properties and roads influences the quality of water in urban drainages. Crimson may elect to collect background samples (two to three samples minimum) upgradient or adjacent to areas affected by the oil release to assess constituents of concern in ballast, French drain backfill, soil and surface water.

Background samples will be collected, preserved and analyzed following the same procedures as project environmental samples.

10.3 FIELD SCREENING, CONFIRMATION AND SPLIT SAMPLES

Not Applicable

10.3.1 Field Screening Samples

Not Applicable

10.3.2 Confirmation Sampling

Random confirmation sample locations will be selected using the “Locating a Hot Spot” feature in the VSP statistical algorithm. In developing the statistical sampling plan the following were assumed:

Null Hypothesis:	The mean concentration is less than the action level.
Alternative Hypothesis:	The mean concentration exceeds the action level.
Confidence Interval:	90 percent.
Hot Spot Diameter:	20 feet.
Grid Pattern:	Triangular.

The Visual Sampling Plan (VSP) software will be used to assess the number of samples required to provide 90 percent confidence that a 20-foot diameter hot spot would not be missed by the confirmation sampling program. Using these assumptions, maps of residual areas of concern (AOC) will be imported into the VSP program to generate random sample locations.

The data collected from the confirmation sampling program will be statistically evaluated to assure that an adequate number of samples are collected and that the data demonstrate a 90 percent confidence level that the mean concentration in the AOC is below the action level. The following errors will be used in the evaluation:

<u>False Rejection error (</u>0.30); and
<u>False Acceptance error (</u>0.05).

The following decision statements will guide confirmation sampling.

If statistical validity is uncertain, then collect additional random samples for analysis. Uncertainty occurs when the null hypothesis is false, but statistical analysis shows that a sufficient number of samples have not been collected.

If the null hypothesis is false, conduct additional removal activity and regenerate random numbers for sample analysis and resample.

If null hypothesis is true, then removal action is complete.

Exceptions to these decision statements may be developed and agreed to by the Unified Command.

The following describe confirmation sampling for each of the potentially affected media.

10.3.2.1 Soil Confirmation Samples

Soil confirmation samples will be collected from identified AOCs where removal actions are implemented and from removal action staging areas. If removal actions are conducted in the french drain system and Youngstown Lateral pipeline area, confirmation soil samples will be collected from safely accessible areas and will be collected using hand augers at randomly selected locations, otherwise the investigation sample results will be used to document residual impacts remaining in the areas.

Confirmation samples will also be collected from staging or support areas to evaluate potential impacts resulting from removal operations.

Soil sample locations will be determined based on visual inspection and evidence of surface impacts. A grid will be overlaid on each area for sampling at the grid nodes. The size of the grid will depend upon the size and geometry of the removal operations which will be determined in the field and approved by the EPA. Confirmation samples will be collected at 0.5 feet below the french drain system.

Depending on the results of the crude oil sample analyses, confirmation samples may be analyzed for one or more of the following:

TEPH-full carbon chain	EPA method 8015B
VOCs	EPA method 8260B

If possible, the list of analytical methods will be reduced based on investigation data to one surrogate analyte (i.e. TEPH) that will be used to assess the efficacy of cleanup activities. Regardless of whether a surrogate is used to guide removal actions, the two confirmation samples exhibiting the highest concentrations of TEPH in each removal operation area will be analyzed for SVOCs and VOCs. If VOC or SVOC analytes exceed removal goals, all of the confirmation samples will be analyzed for the analyte(s) of concern for statistical evaluation of mean residual concentrations.

10.3.2.2 Surface Water Confirmation Samples

It is not anticipated that sampling of surface waters from the Dominguez Channel will be required. However, should it be determined by the Unified Command, that surface water confirmation sampling is necessary, surface water confirmation samples will be collected from Dominguez Channel using a weighted clean sample jar or sample dipper. In most cases these jars will be the sample jar, with the exception of sample containers containing preservative. For these samples, water contained in a sample jar will be carefully decanted into glass VOAs or bottles to reduce turbulence for preservation and delivery to the laboratory as indicated in subsequent sections.

Requested surface water samples will be collected from Dominguez Channel for the following list provides project analytes and their associated methods:

TEPH full hydrocarbon chain	EPA method 8015B
VOCs	EPA method 524.2

10.3.3 Split Samples

Split samples may be collected depending on the results of primary samples, laboratory QA/QC results, and the degree of heterogeneity reported in duplicate samples. Split samples will be submitted to an independent third party laboratory for analysis and comparison with primary laboratory samples. At this point, split sample analysis is not anticipated.

10.4 LABORATORY QUALITY CONTROL SAMPLES

Laboratory QC samples are analyzed as part of standard laboratory practice. The laboratory monitors the precision and accuracy of the results of its analytical procedures through analysis of QC samples.

Laboratory QC checks are detailed in the laboratory QAM. In general, the QC requirements include the following:

- Trip blanks;
- Reagent/preparation/calibration blanks (applicable to inorganic analysis);
- Instrument blanks;
- Initial calibration;
- Initial calibration verification;
- Continuing calibration verification;
- MDL verification;
- Method RL verification;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates;
- LCS samples;
- Internal standard areas for Gas Chromatograph/Mass Spectrometer (GC/MS) analysis; and,
- Mass tuning for GC/MS analysis.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. The laboratory should re-analyze any samples analyzed in non-conformance with the QC criteria, if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for re-analysis when necessary. Data packages will be available in electronic form.

11.0 FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. Also, as conditions are revealed and AOCs are better defined, modifications are expected with respect to confirmation sampling locations, etc. All field variances will be recorded on a Variance / Time Delay Form (ERPA-302), the Unified Command will be notified, and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented by updating this SAP.

12.0 FIELD HEALTH AND SAFETY PROCEDURES

A site specific health and safety plan (HASP) has been developed for this project under separate cover. In addition, each SOP includes a section on Health and Safety Considerations.

TABLES

Table 2-1: Contaminants of Concern – Previous Investigations (Matrix = solid)

Analytical Parameter (Contaminants of Concern)	Date of sampling	Sampling contractor	Laboratory Analytical Results[1] (units)	Regulatory Limit
TPH gasoline (C4-C12)	4/26/2011	WGR Southwest	960 mg/kg	
TPH diesel (C13-C28)	4/26/2011	WGR Southwest	41,800 mg/kg	
TPH oil (C29-C40)	4/26/2011	WGR Southwest	2,800 mg/kg	
Benzene	4/26/2011	WGR Southwest	ND < 670 ug/kg	5.4 mg/kg (RSL)
Toluene	4/26/2011	WGR Southwest	ND < 670 ug/kg	45,000 mg/kg (RSL)
Ethylbenzene	4/26/2011	WGR Southwest	ND < 670ug/kg	27 mg/kg (RSL)
Xylenes, total	4/26/2011	WGR Southwest	2,100 ug/kg	2,700 mg/kg (RSL)
Naphthalene	4/26/2011	WGR Southwest	2, 700 ug/kg	18 mg/kg (RSL)
Mercury	4/26/2011	WGR Southwest	0.074 mg/kg	43 mg/kg (RSL)
Antimony	4/26/2011	WGR Southwest	16.0 mg/kg	410 mg/kg (RSL)
Arsenic	4/26/2011	WGR Southwest	5.3 mg/kg	1.6 mg/kg (RSL)
Barium	4/26/2011	WGR Southwest	9.2 mg/kg	190,000 mg/kg (RSL)
Beryllium	4/26/2011	WGR Southwest	ND < 0.49 mg/kg	2,000 mg/kg (RSL)
Cadmium	4/26/2011	WGR Southwest	ND < 0.49 mg/kg	800 mg/kg (RSL)
Chromium	4/26/2011	WGR Southwest	14.0 mg/kg	1,500,000 mg/kg (RSL)
Cobalt	4/26/2011	WGR Southwest	5.2 mg/kg	300 mg/kg (RSL)
Copper	4/26/2011	WGR Southwest	22.0 mg/kg	41,000 mg/kg (RSL)
Lead	4/26/2011	WGR Southwest	23.0 mg/kg	800 mg/kg (RSL)
Molybdenum	4/26/2011	WGR Southwest	ND < 2.0	5,100 mg/kg (RSL)
Nickel	4/26/2011	WGR Southwest	18.0 mg/kg	20,000 mg/kg (RSL)
Selenium	4/26/2011	WGR Southwest	ND < 2.0 mg/kg	5,100 mg/kg (RSL)
Silver	4/26/2011	WGR Southwest	ND < 0.99 mg/kg	5,100 mg/kg (RSL)
Thallium	4/26/2011	WGR Southwest	ND < 9.9 mg/kg	10 mg/kg (RSL)
Vanadium	4/26/2011	WGR Southwest	27.0 mg/kg	5,200 mg/kg (RSL)
Zinc	4/26/2011	WGR Southwest	91.0 mg/kg	310,000 mg/kg (RSL)
Total Extractable Petroleum Hydrocarbons (TEPH)				10,000 mg/kg (clean up goal)

mg/kg = milligrams per kilogram

1 – Crude oil sample, not representative of soil data.

RSL –Regional Screening Level for Industrial Soil (EPA, June 2011)

Table 2-2: Contaminants of Concern – Previous Investigations (Matrix = water)

Analytical Parameter (Contaminants of Concern)	Date of sampling	Sampling contractor	Laboratory Analytical Results[1] (units)	Regulatory Limit
TPH gasoline (C4-C12)	4/26/2011	WGR Southwest	4,600 ug/L	
TPH diesel (C13-C28)	4/26/2011	WGR Southwest	2.99 mg/L	
TPH oil (C29-C40)	4/26/2011	WGR Southwest	1.89 mg/L	
Benzene	4/26/2011	WGR Southwest	ND < 2.0 ug/L	
Toluene	4/26/2011	WGR Southwest	ND < 2.0 ug/L	
Ethylbenzene	4/26/2011	WGR Southwest	ND < 2.0 ug/L	
Xylenes, total	4/26/2011	WGR Southwest	ND < 4.0 ug/L	
Naphthalene	4/26/2011	WGR Southwest	ND < 5.0 ug/L	
Mercury	4/26/2011	WGR Southwest	ND < 0.00020 mg/L	
Antimony	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Arsenic	4/26/2011	WGR Southwest	0.083 mg/L	
Barium	4/26/2011	WGR Southwest	0.012 mg/L	
Beryllium	4/26/2011	WGR Southwest	ND < 0.0040 mg/L	
Cadmium	4/26/2011	WGR Southwest	ND < 0.0050 mg/L	
Chromium	4/26/2011	WGR Southwest	ND < 0.0050 mg/L	
Cobalt	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Copper	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Lead	4/26/2011	WGR Southwest	ND < 0.0050 mg/L	
Molybdenum	4/26/2011	WGR Southwest	0.043 mg/L	
Nickel	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Selenium	4/26/2011	WGR Southwest	0.011 mg/L	
Silver	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Thallium	4/26/2011	WGR Southwest	ND < 0.010 mg/L	
Vanadium	4/26/2011	WGR Southwest	0.012 mg/L	
Zinc	4/26/2011	WGR Southwest	0.090 mg/L	

mg/kg = milligrams per kilogram

1 – Crude oil sample, not representative of water data.

Table 2-3: Contaminants of Concern – Previous Investigations (Matrix = oil)

Analytical Parameter (Contaminants of Concern)	Date of sampling	Sampling contractor	Laboratory Analytical Results[1] (units)	Regulatory Limit
TPH gasoline (C4-C12)	8/30/11	WGR Southwest	110,000 mg/kg	
TPH diesel (C13-C28)	8/30/11	WGR Southwest	380,000 mg/kg	
TPH oil (C29-C40)	8/30/11	WGR Southwest	110,000 mg/kg	
Benzene	8/30/11	WGR Southwest	200 mg/kg	
Toluene	8/30/11	WGR Southwest	610 mg/kg	
Ethylbenzene	8/30/11	WGR Southwest	320 mg/kg	
Xylenes, total	8/30/11	WGR Southwest	1,200 mg/kg	
Naphthalene	8/30/11	WGR Southwest	120 mg/kg	
Mercury	8/30/11	WGR Southwest	ND < 0.020 mg/kg	
Antimony	8/30/11	WGR Southwest	ND < 10 mg/kg	
Arsenic	8/30/11	WGR Southwest	ND < 2.0 mg/kg	
Barium	8/30/11	WGR Southwest	2.7 mg/kg	
Beryllium	8/30/11	WGR Southwest	ND < 0.50 mg/kg	
Cadmium	8/30/11	WGR Southwest	ND < 0.50 mg/kg	
Chromium	8/30/11	WGR Southwest	ND < 1.0 mg/kg	
Cobalt	8/30/11	WGR Southwest	ND < 1.0 mg/kg	
Copper	8/30/11	WGR Southwest	ND < 2.0 mg/kg	
Lead	8/30/11	WGR Southwest	ND < 2.0 mg/kg	
Molybdenum	8/30/11	WGR Southwest	ND < 2.0 mg/kg	
Nickel	8/30/11	WGR Southwest	20 mg/kg	
Selenium	8/30/11	WGR Southwest	ND < 2.0 mg/kg	
Silver	8/30/11	WGR Southwest	ND < 1.0 mg/kg	
Thallium	8/30/11	WGR Southwest	ND < 10 mg/kg	
Vanadium	8/30/11	WGR Southwest	16 mg/kg	
Zinc	8/30/11	WGR Southwest	ND < 5.0 mg/kg	

mg/kg = milligrams per kilogram
1 – Crude oil sample.

Table 5-1: Analytical Method, Containers, Preservation, and Holding Times Requirements
Matrix = Soil

Analytical Parameter and/or Field Measurements	Analytical Method Number	Containers (number, type, size/volume)	Preservation Requirements (chemical, temperature, light protection)	Maximum Holding Times
Volatile Organics by GC/MS	EPA 8260B	3 x 5g Encore OR 3 x Terracore OR 1 x brass sleeve	Frozen within 48 hours	14 days
Semi-Volatile Organics	EPA 8270C	1 x brass sleeve OR 1 x 8 oz jar	Cool to 4 degrees C	14 days
DRO/ORO/EFH	EPA 8015B	1 x brass sleeve OR 1 x 8 oz jar	Cool to 4 degrees C	14 days
Total Metals	EPA 6020B	1 x brass sleeve OR 1 x 4 oz jar	Cool to 4 degrees C	180 days

Table 5-2: Analytical Method, Containers, Preservation, and Holding Times Requirements
Matrix = Water

Analytical Parameter and/or Field Measurements	Analytical Method Number	Containers (number, type, size/volume)	Preservation Requirements (chemical, temperature, light protection)	Maximum Holding Times
Volatile Organics by GC/MS	EPA 8260B	3 x 40 mL VOA	Cool to 4 degrees C HCl	14 days
Semi-Volatile Organics	EPA 8270C	2 x 1L amber	Cool to 4 degrees C	7 days
DRO/ORO/EFH	EPA 8015B	2 x 1L amber	Cool to 4 degrees C	7 days
Dissolved Metals (Field filtered with 0.45 micron filter)	EPA 200.8	1 x 500mL poly	HNO_3	180 days

Table 5-3
Data Validation and Acceptance Criteria
Quality Assurance Project Plan

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Holding Time	Each sample should meet holding times. Holding times for VOCs are presented in the SAP.	Analytical results flagged as estimated concentrations (J) or as estimated quantitation limits (UJ). A slight exceedance may not be qualified at the discretion of the data validator.
Trip Blanks	Contaminants are not present in the blanks.	Flag values as estimated (J) if less than 10X for method specific laboratory contaminants and 5X for other contaminants. Request that laboratory review data. Carefully consider type of blank, compounds present, and origin of contaminants. Modify sampling procedures or laboratory SOPs.
Field Duplicates	RPD for water = 25%, for solids = 50%.	Field duplicate exceeds RPD criteria. Review sampling procedures and request that laboratory review data.
Practical Quantitation Limits	Positive results are above the lowest practical quantitation limit. If dilution is required as a result of matrix interference, the practical quantitation limits will be adjusted by the laboratory and the lowest practical quantitation limits may not be achievable.	Concentrations reported below the practical quantitation limit will be flagged as estimated (J). Review sensitivity data and discuss specific results with testing laboratory in a qualitative manner to determine if re-analysis or modification of procedures should be performed to meet desired objectives.

Table 5-3
Data Validation and Acceptance Criteria
Quality Assurance Project Plan

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Matrix Spike/Matrix Spike Duplicate	RPD for water = 25%, for solids = 50%. Spike recoveries for water = 70% - 130% (requested); 50%-150%(maximum) Spike recoveries for solids = 60% - 140% (requested); 50%-150% (maximum)	Re-analyze MS/MSD to verify recovery problem is due to matrix interference. Data are not qualified based on MS/MSD results alone. Verify that the associated LCS is within QC limits.
Surrogates	RPD for water = 25%, for solids = 50%. 8260B surrogate recoveries for water = 70% - 130% 8260B surrogate recoveries for solids = 60% - 140% 8270C surrogate recoveries for water = 70% - 130%(requested); 60%-140% (maximum) 8270C surrogate recoveries for soilds = 60% - 140%	Samples with surrogate recoveries below QC limits will be flagged as estimated (J) for detected results and (UJ) for nondetects. Samples with surrogate recoveries above QC limits will be flagged as estimated (J) for detected results. Nondetects will not be qualified. In all cases, qualification of the data is at the discretion of the data validator, i.e., where dilutions are involved, the validator may determine that data qualifications are not necessary.
Laboratory Control Sample	RPD for water = 25%, for solids = 50%. 8260B LCSrecoveries for water = 75% - 125% 8260B LCS recoveries for solids = 70% - 130% 8270C LCS recoveries for water = 70% - 130% (requested); 60%-140%(maximum) 8270C LCS recoveries for soilds = 60% - 140%	Review data and discuss with laboratory. Re-analysis may be necessary. Data qualifications may be necessary at the discretion of the data validator.
Initial Calibration	Organics - % RSD is less than 30 for calibration check compounds and less than 15 for other analytes.	Laboratory should recalibrate instrument. Samples run on ICAL which is out of QC limits are qualified as estimated (J) for detected results and (UJ) for nondetects.

Table 5-3
Data Validation and Acceptance Criteria
Quality Assurance Project Plan

Data Validation Parameter	Acceptance Criteria	Guidelines for Corrective Action
Continuing Calibration Verification	Organics - % D is less than 20% for calibration check compounds.	Calibration standard should be re-injected. A new calibration curve should be run if re-injection fails. Analyses associated with the CCAL will be qualified as estimated (J) for detected results and (UJ) for nondetects.
General Quality of Data	Completeness of data should range between 90 and 100 percent complete.	Review completeness data and discuss results with testing laboratory in a qualitative manner to determine if re-analysis or modification of procedures should be performed to meet desired objectives.

Note: Table 2 is to be used for data validation for each validation point, where applicable. Specific determinations of data validity should be based on review of the data and circumstances associated with the samples tested and guidance regarding data validation.

<u>Data Validation Qualifiers</u>

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is an estimated quantity.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a 'tentative identification.'
NJ	The analysis indicates the presence of an analyte that has been 'tentatively identified' and the associated numerical value is an estimated quantity.
UJ	The analyte was not detected above the reported sample quantitation limit. The associated quantitation limit is estimated.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Table 5-4
Laboratory MDLs and RLs
Quality Assurance Project Plan

Target Analyte	Waters		Soils	
	RL mg/L	MDL mg/L	RL mg/Kg	MDL mg/Kg
Benzene	0.005	0.001	0.005	0.001
Toluene	0.005	0.0025	0.005	0.0025
Ethylbenzene	0.005	0.0025	0.005	0.0025
Xylenes, Total	0.005	0.0031	0.005	0.0025
Biochemical Oxygen Demand	5	2.0	n/a	n/a
Chemical Oxygen Demand	10	7.8	n/a	n/a
Nitrate	0.1	0.05	5	2.5
Sulfate	5	2.5	50	25
Acenaphthene	0.001	0.0005	0.025	0.012
Acenaphthylene	0.001	0.0005	0.025	0.012
Anthracene	0.0001	0.00005	0.025	0.012
Benz[a]anthracene	0.0001	0.00005	0.025	0.012
Benzo[a]pyrene	0.0001	0.00005	0.025	0.012
Benzo[b]fluoranthene	0.0001	0.00005	0.025	0.012
Benzo[k]fluoranthene	0.0001	0.00005	0.025	0.012
Benzo[g,h,i]perylene	0.0001	0.00005	0.025	0.012
Chrysene	0.0005	0.00025	0.025	0.012
Dibenz[a,h]anthracene	0.0001	0.00005	0.025	0.012
Fluoranthene	0.001	0.0005	0.025	0.012
Fluorene	0.001	0.0005	0.025	0.012
Indeno[1,2,3-cd]pyrene	0.0001	0.00005	0.025	0.012
2-Methylnaphthalene	0.001	0.0005	0.025	0.012
Naphthalene	0.001	0.0005	0.025	0.012
Phenanthrene	0.001	0.0005	0.025	0.012
Pyrene	0.001	0.0005	0.025	0.012

Notes:
RL: Reporting Limit
MDL: Method Detection Limit

ATTACHMENT A

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for collecting soil samples when drilling with hollow-stem augers, direct push, and hand auger methods. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure provides descriptions of equipment, field procedures, sample containers, decontamination, documentation, decontamination, storage, holding times, and field quality assurance (QA) and quality control (QC) procedures necessary to collect soil samples.

While the Project Quality Assurance Project Plan (QAPP) is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result, such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
USCS	Unified Soil Classification System
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

3.0 HEALTH AND SAFETY CONSIDERATIONS

Refer to the site-specific Health and Safety Plan (HASP) for health and safety considerations applicable to soil sampling.

Many hazards should be considered during the soil sampling activities, careful consideration of these hazards by the project team is essential. Some of the hazards include the following:

- Proper utility clearance must be performed in accordance with the Pre-Drilling/Excavation Checklist and Utility Clearance Log. There must be a minimum clearance of five (5) feet in addition to the diameter of the drilling augers. Client-specific requirements may be more restrictive.
- Traffic control may be required depending on the proximity of soil sampling activities to the roadway. Traffic control plans should be carefully evaluated to adequately delineate the work zone and provide the necessary safety factors.
- Personal protective equipment (PPE) including hard hats, high visibility traffic vest, gloves, hip boots or chest waders and other appropriate clothing;
- Heat and cold stress;
- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.
- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.
- Decontamination of equipment and personnel must be properly designed and constructed to be sure that contamination is kept within the boundaries of the exclusion zone;
- Noise and proper use of hearing protection devices such as ear plugs and muffs.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractors and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Soil sampling shall be done by personnel familiar with the common sources of random and systematic error so appropriate decisions can be made in the field. Some of the common phenomena which may degrade the sample quality collected from the well point are listed below.

- **Volatilization.** Volatilization occurs when the sample is in contact with air for an extended time. Typically volatilization occurs if the sample undergoes excessive disturbance during sampling or if air pockets exist at the top of the container. Limiting disturbance during sampling, filling sample containers in order of volatility, and tight capping of bottles immediately after filling will minimize these errors.

- **Adsorption/desorption.** This is the gain or loss of chemicals through exchange across surfaces. Adsorption may occur when the sample comes in contact with large surface areas such as the sampling container. Thorough decontamination of sample collection containers/monitoring equipment probes along with expedient transfer from the sample container to the labrotory container minimizes sorption effects.

- **Chemical reaction.** Dissolved chemical constituents may change due to reactions such as oxidation, hydrolysis, precipitation, etc. Proper preservation and adherence to holding times minimize these reactions.

- **Sample contamination.** Sample contamination is the most common source of errors and can result from several factors, including incomplete decontamination, contact with other samples, and contact with the atmosphere. Careful attention to decontamination, handling, and container sealing minimizes sample contamination.

5.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete soil sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the well point installation and sediment pore water sampling will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager or Project QA/QC Officer.

6.0 TRAINING AND QUALIFICATIONS

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform soil sampling will be required to have:

- Read this SOP.

- Read project-specific QAPP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the Occupational Safety and Health Administration (OSHA) 40-hour training course, and/or annual 8-hour refresher course, as appropriate.
- Coordinated any proposed sampling activites with the laboratory to ensure proper sampling procedures.
- Previously performed soil sampling activities generally consistent with those described in this SOP.

Stantec employees who do not have previous experience with soil sampling will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures.

7.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform soil sampling:

- Auger rig or direct-push unit with appropriate equipment for sampling, or hand auger.
- Continuous soil sampler (2-½-inch x 18-inch or 2-foot split-spoon sample tube) or direct-push clear acetate or polyvinyl chloride PVC tube (typically 4-foot long).
- Photoionization detector (PID) or other air monitoring instrumentation as required by the HASP.
- 4-mil-thick plastic sheeting or aluminum foil.
- Tape measure.
- Unified Soil Classification System (USCS) based on the Visual-Manual Procedures in ASTM Standards D 2487-00 and D 2488-00.
- 5035 sample containers with lids.
- Terra-cores™ or similar coring sampling device, if required.
- Sample labels.
- Stainless steel trowels, putty knives or similar soil working tool.
- Penetrometer (if available).
- Waterproof marking pens, such as the Staedtler Lumocolor.
- Coolers (with ice) for sample storage and shipment.

- Sample data forms/clip board.
- Decontamination supplies (Alconox™ [or similar detergent], brush, bucket).
- Nitrile gloves, or other specified chemical resistant gloves.
- Work gloves.
- Camera and film or disks.
- Blank soil borehole logs or a field-logging PDA.
- Personal safety gear (hard hat, steel-toed boots, ear plugs, safety glasses, etc.).

8.0 METHODS

8.1 Hollow-Stem Auger/Direct Push Sampling

Make sure that all equipment and meters have been calibrated to the equipment specifications and the results have been recorded in the field log.

The top five (5) feet of the boreholes will be cleared via air knife, vacuum excavation, ground penetrating radar, hand auger, tile probe or some combination of these methods.

Shallow soil boreholes are typically drilled with hollow-stem augers or geoprobe and sampled at the intervals specified in the work plans. Sampling shall be done in advance of the lead auger to minimize cross-contamination. Samples for laboratory analysis shall be taken with a continuous soil sampler. Standard blow counts shall be recorded for driving the sampler 6 and 12 inches (ASTM Method D 1586-99) if sampler is hammer driven.

Upon retrieval of the sample, the sample will placed on a clean surface (or lined with disposable aluminum foil or plastic sheeting) and will be screened with a PID for locating potential elevated PID readings. If applicable, a representative grab sample will be collected along with a headspace sample and placed into the appropriately labeled sample container. The sample containers shall be placed in self-sealing plastic or bubble bags in a cooler with ice or frozen ice packs for storage until they are delivered to the analytical laboratory.

The following method is to be used for headspace screening:

- The portion (for headspace screening) should be placed into an appropriately sized re-sealable Ziploc® or equivalent bag;
- Seal and label the bag with the borehole identification and the depth of the sample;
- Allow the bag to equilibrate for approximately ten (10) minutes; and
- Insert the probe tip of the PID into the bag. Obtain a measurement using the PID.

The remainder of the sample shall be logged in accordance with the USCS and recorded on the boring logs according to the following procedure:

1. As much information as possible is to be shown in the heading of each log. This includes, but is not limited to:

   - Project name and project identification number;
   - Identification of borehole;
   - Name of drilling company;
   - Make, model, type, and size of drilling and sampling equipment used;
   - Date and time of start and end of drilling
   - Name of geologist(s) logging boring;
   - End of boring depth; and,
   - Depth to water (if encountered).

2. Each log is to begin with a description of the surface, (i.e., native, paved with asphalt, paved with concrete, and such). If any concrete is cut to open the hole, the thickness will be noted.

3. Every foot will be accounted for, with no gaps. If an interval is not sampled it will be noted. If an attempt is made to sample an interval, but there is no recovery, it will be noted.

4. Complete construction details are to be detailed for each well on a standard well construction form. Construction details should include:

   - A description of the type and length of casing i.e., 20' of 2" inner diameter (ID) Schedule 40 PVC casing;
   - Length and depths of the top and bottom of the screened interval;
   - Screen slot size;
   - Depths of the top and bottom of the filter pack;
   - Filter pack materials and sand size;
   - Depths and types of bentonite seals;
   - Detail of the use of grout; and,
   - Detail of the surface completion (i.e., stick up, flush-mounted).

5. The number of bags of sand, bentonite, and grout used will be counted. These numbers will be compared daily with the driller's daily report.

Soil cuttings will be stockpiled on 4-mil thick plastic sheeting or drummed. The cuttings and other investigation-derived waste will be managed in accordance with the work plan or client-specific directives.

When sampling for volatile organic compounds (VOCs), use USEPA Method 5035. Method 5035 requires ample preservation in the field at the point of collection. The preservative used for the low concentration soil method (0.5 to 200 µg/kg) is sodium bisulfate and the preservative used for the medium/high concentration soil method (>200 µg/kg) is methanol. This field collection and preservation procedure is intended to prevent loss of VOCs during sample transport, handling, and analysis. The holding time for VOC analysis is 14 days.

1. Use the lab provided plunger style sampler (T-handle, syringe with tool, or terra-core™ sampler) to collect a 5g soil sample.

2. Unscrew the lid of the lab provided pre-preserved sodium bisulfate volatile organic analysis (VOA) vials and inject the 5g soil sample.

3. Tightly seal the VOA vial.

4. Repeat this step with the second sodium bisulfate VOA vial.

5. Then, repeat with the methanol preserved VOA vial.

6. Collect a soil sample in the 4-ounce wide mouth glass jar provided by the lab.

7. Make sure sample containers are labeled and bagged in plastic or bubble bags.

8. Ice the samples.

8.2 Hand Auger Sampling

Shallow soil boreholes less than five (5) feet in depth can be collected using a hand auger. The auger will be advanced until the desired sampling depth is reached. The auger will be removed from the boring, the sample will be extracted from the hand auger and field screened (as appropriate), and representative grab samples will be collected and placed into the appropriate labeled sample container. Decontamination of the auger and extensions will occur after each sample.

Boreholes will be abandoned by backfilling with bentonite chips and hydrating with potable water.

8.3 Excavation

Excavations and test pits will be excavated using a backhoe provided by the subcontractor. The dimensions of individual excavations will vary depending on the strength and stability of the trench walls and the specific purpose of the trench. Excavations greater than four (4) feet deep will not be entered by any personnel unless shoring is performed or the sides are stepped back to the proper angle per OSHA requirements.

When starting an excavation, the backhoe operator will first remove the topsoil or cover (if any) and place it in a discrete mound at least five (5) feet from the edge of the excavation. The excavation will be continued in approximately 6-inch cuts with the backhoe using a horizontal scraping motion rather than a vertical scooping motion. If a visibly-stained or otherwise chemically-affected soil interval is encountered, the affected excavated soils will be placed on 4-mil thick plastic sheeting.

8.3.1 Excavation Sampling

Samples will be collected from the backhoe bucket using a stainless steel trowel or similar. The top layer of soil will be removed prior to collecting the sample. The soil will then be placed in the appropriately labeled sample container and placed inside a chilled cooler.

8.3.2 Excavation Backfilling

The soils will be replaced in the excavation at their original depths to the extent practicable so that the soil from the bottom of the trench will be placed on the bottom, and the topsoil will be replaced on the top. The backhoe will be used to backfill and compact the excavation.

Upon completion and subsequent backfilling of each excavation, four corners will be marked with a wooden stake for surveying. If appropriate, a fifth stake will be placed above the location where a soil sample was collected. The points may be surveyed, as needed.

8.4 Decontamination Methods

8.4.1 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed to be sure that the solutions used are appropriate for the chemicals of interest.
- Ensure that the decontamination area is properly constructed to keep contamination within the contamination reduction and exclusion zones.
- Ensure that the decontamination area is properly constructed to contain the rinse solutions and solids.
- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Smaller equipment that will not be damaged by water will be placed in a wash bucket containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Smaller equipment will be rinsed in water. Change rinse and detergent waters between boreholes, as needed.
- For larger drilling equipment the soil and/or other material will be scraped off with a flat-bladed scraper, and placed within a deconcontamination (decon) pad. The decon pad will be constructed in a predetermined location, and equipment shall be cleaned with a pressure washer using potable water. Care will be taken to adequately clean the insides of the hollow-stem augers, and cutter heads.
- Equipment that may be damaged by water will be carefully wiped clean using a

sponge and detergent water and rinsed in or wiped down with distilled water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with potentially contaminated soil.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it will be stored in the designated secure, clean area.

8.4.2 Excavation Decontamination

Decontamination protocols must be carefully designed and constructed to deal with the chemicals of interest and ensure that the rinse solutions and solids are contained within the contamination reduction zone.

The backhoe bucket will be decontaminated prior to excavating each excavation. The entire backhoe, bucket, and tires will be decontaminated at the conclusion of the trenching operation. Decontamination will involve using a steam cleaner with an Alconox™ solution or pressure washer and rinsing using a steam cleaner or pressure washer with potable water. Backhoe decontamination will take place at the decontamination area located adjacent to the maintenance building or at another appropriate location.

The sampling equipment will be decontaminated prior to collecting each sample. Decontamination will consist of washing the equipment with a scrub brush in a bucket with an Alconox™ solution (or equivalent) and rinsing the equipment in a bucket filled with tap water. The date and time of decontamination of the backhoe and sampling equipment will be recorded in the field book and/or data collection forms.

8.5 Sample Containers, Storage, and Holding Times

Refer to the Project Sampling and Analysis Plan (SAP) for project specific instructions on proper containers, storage of samples and allowable holding times.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the QAPP and SAP for specific quality control checks and acceptance criteria.

10.0 DOCUMENTATION

A borehole log will be completed for each hollow-stem auger or direct-push borehole. The field notebook and/or data collection forms will contain the following information:

- Project name and number.
- Drilling company's name.
- Date drilling started and finished.
- Type of auger and size (ID & OD).

- Type of equipment for air monitoring (PID or FID).
- Air monitoring calibration and measurements.
- Well completion and graphic log.
- Driller's name.
- Geologist's or engineer's name.
- Type of drill rig.
- Borehole number.
- Surface elevation (if available).
- Stratigraphic description with depth.
- Classification of the soils according to the USCS.
- Water levels and light non-aqueous phase liquid levels, if applicable.
- Drilling observations.
- Map of borehole or monitoring well location.

In addition, proper documentation will include observance of the chain of custody procedures as described in the Project QAPP and SAP.

Additional information regarding field documentation for borehole logging for fine- and coarse-grained soils and rocks are provided in Stantec checklists ERPA-603 through ERPA-605.

ACCEPTANCE

____
Author/Originator

____
Peer Reviewer

____
Senior Reviewer

____
Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for decontamination procedures. The ultimate goal of the decontamination procedure is to prevent cross-contamination between samples and sample areas and to protect workers from hazardous materials.

This procedure gives descriptions of equipment and field procedures necessary to perform decontamination.

This procedure may apply to all sampling by Stantec personnel or their subcontractors by the aforementioned sampling methods.

It must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance and sufficiently documented so that the reason for the deviation can be clearly articulated to our clients and regulators, as necessary. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity.

2.0 DEFINITIONS

FSP	Field Sampling Plan
HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review may be performed by modifying a generic or an existing Job Safety Analysis in the HASP. Following is a short list of the items for consideration. Careful review of these items and other site-specific conditions by the project team is essential.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.

- Personal protective equipment, including hard hats, high-visibility traffic vest, gloves, appropriate clothing.

- Heat and cold stress.

- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.

- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.

- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.

- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.

- The exclusion and contaminant reduction zones must be properly designed and constructed so that contamination from decontamination activities of equipment and personnel is kept within this area.

- Noise and proper use of hearing protection devices such as ear plugs and muffs.

- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractor and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete decontamination activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the decontamination tasks will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to oversee decontamination will be required to have:

- Read this SOP;
- Read project-specific QAPP;
- Indicated to the Task Leader that all procedures contained in this SOP are understood;
- Completed the OSHA 40-hour training course and 8-hour refresher course, as appropriate; and,
- Previously performed decontamination activities generally consistent with those described in this SOP.

5.0 TRAINING/QUALIFICATIONS

Stantec employees who do not have previous experience with decontamination will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures.

6.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform decontamination:

- Paper towels;
- Aluminum foil;
- Trash bags;
- Non-phosphate detergent (e.g., Alconox™);
- Distilled or deionized water (where available);
- Spray bottles;
- Cleaning brushes;
- 5-gallon buckets, purge tank, trailer, drums and drum labels or waste containers;
- Nitrile gloves, or other specified chemical resistant gloves;
- Work gloves; and,
- Personal protective equipment (hard hat, steel-toed boots, etc.).

7.0 DECONTAMINATION METHODS

Reusable field instrumentation and sampling equipment will be decontaminated prior to their first use, and between each well/sampling location in which they are used. Two types of decontamination procedures will be employed, depending on the level of visual or otherwise known contamination to which the instrumentation is exposed. Pre-use decontamination will follow the first decontamination protocol listed below.
Reusable instrumentation/equipment that has signs of visible NAPL or has potentially come in contact with NAPL-impacted material will be decontaminated in the following manner:

1. The instrumentation/equipment will be thoroughly rinsed with tap water to remove sediment and debris, after caked on material has been physically removed.

2. The instrumentation and sampling equipment will be thoroughly washed with a mixture comprised of approximately two (2) tablespoons of Alconox™ (or similar low phosphate cleaning agent) per 1-gallon of de-ionized water. A stiff bristle scrub brush will be used if necessary to provide thorough cleaning.

3. The instrumentation/equipment will be triple-rinsed with unused distilled or de-ionized water where available.

The effectiveness of the above decontamination procedures will be demonstrated through the periodic use of equipment blanks. A more detailed discussion of the proposed use of equipment blanks is provided in the FSP

Drill rigs or Geoprobes used on site will be thoroughly decontaminated prior to their arrival at the site and prior to initiation of any drilling activities. The rig and its equipment will be thoroughly examined to ensure that there are no significant fuel, hydraulic fluid, transmission oil, and/or motor oil leaks that could create a condition not previously in existence or exacerbate an existing condition.

Once the rig and its equipment have been thoroughly cleaned and inspected, subsequent decontamination efforts will focus only on those pieces of equipment which actually come into contact with soils or groundwater. No petroleum hydrocarbon based lubricants will be allowed on the drill stems or associated connections. Both the initial comprehensive cleaning of the rig and subsequent decontamination procedures will be performed using either steam-cleaning equipment or high pressure hot water/detergent wash. In addition, casing centralizers and casing handling equipment, if used, will be cleaned prior to use in the construction of monitoring wells.

Decontamination wash solutions and rinsate will be collected and containerized in 5-gallon buckets, 55-gallon drums, or poly tanks. The collected rinsate will be disposed of appropriately.

8.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

9.0 DOCUMENTATION

A record will be maintained during the purging procedure that will contain at a minimum:

- Project name and number;
- Date, personnel;
- Decontamination procedures;
- Volume of rinsate fluid generated during decontamination; and,
- Disposal method of decontamination water.

The data shall be recorded on a log form or in field logs.

ACCEPTANCE

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Author/Originator

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Peer Reviewer

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Senior Reviewer

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Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for the collection of surface water grab samples for laboratory analysis. The ultimate goal of the sampling program is to obtain grab samples that meet acceptable standards of accuracy, precision, comparability, representativeness and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure provides descriptions of equipment, field procedures, sample containers, decontamination, documentation, storage, holding times, and field Quality Assurance/Quality Control (QA/QC) procedures necessary to collect surface water samples.

This procedure may apply to all surface water grab sampling by Stantec personnel or their subcontractors.

While the Quality Assurance Project Plan (QAPP) is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the SOP shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result, such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

GPS	Global Positioning System
HASP	Health and Safety Plan
OSHA	Occupational Safety & Health Administration
PFD	Personal Flotation Device
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
USGS	United States Geological Survey
UTM	Universal Transverse Mercator Coordination System
VOC	Volatile Organic Compound

3.0 HEALTH AND SAFETY CONSIDERATIONS

Refer to the site-specific Health and Safety Plan (HASP) for health and safety considerations applicable to surface water sampling.

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review can be performed by making our generic Job Safety Analysis site-specific in our site-specific HASP. Of course, there are many items that need to be considered. The following is just a short list of the items. Careful consideration of these items by the project team is essential, and the ultimate responsibility of the project manager.

- Slips, trips, and falls and uneven terrain are likely to be encountered while accessing surface water or wading in surface water. Felt-soled boots may be appropriate.

- Drowning is a risk near any surface water and a Personal Flotation Device (PFD) should be worn at all times when working near any type of surface water.

- Water velocity needs to be determined if personnel will be wading into the surface water. Flowing water in which personnel may safely wade is generally defined by the United States Geological Survey (USGS) by multiplying the depth of the water (ft) by the velocity (ft/sec) and ensuring the product is less than 10. The stature and weight of the field personnel, in addition to the conditions of the streambed, should also be considered. Safety lines may also be appropriate depending on the conditions.

- Ice thickness should be determined before accessing frozen surface water.

- Personal protective equipment (PPE) including PFD, high visibility traffic vest, gloves, hip boots or chest waders, and other appropriate clothing.

- Indications of heat and cold stress should be discussed with field personnel and action items identified.

- A visual survey of biological hazards such as insects and spiders should be performed. Appropriate clothing is required such as long-sleeved shirts and long pants.

- Possible blood borne pathogens should be discussed. Some of our sites may have syringes and other drug paraphernalia that must be avoided.

- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.

- Use of air monitoring instrumentation will not likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.

- Decontamination of equipment and personnel must be properly designed and constructed to be sure that contamination is kept within the boundaries of the exclusion zone.

- Noise and proper use of hearing protection devices such as ear plugs and/or muffs, if required.

- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client and emergency responders.

- Ergonomics should be considered when setting up equipment. Ensure that staff does not lift more than 50 lbs alone or over extend during sampling.

All of these risks and others must be discussed with our subcontractors, if applicable, and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff performing the work. Details of procedures, instrument measurements, and other activities must be recorded in the field log and/or on data collection forms.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Sampling shall be done by personnel familiar with the common sources of random and systematic error so intelligent decisions can be made in the field. Some of the common phenomena which may degrade sample quality are listed below:

- **Volatilization.** Volatilization occurs when the sample is in contact with air for an extended time. Typically volatilization occurs if the sample undergoes excessive agitation during sampling or if air pockets exist at the top of the water container. Limiting agitation during sampling, filling sample containers in order of volatility, and tight capping of bottles immediately after filling will minimize these errors.

- **Adsorption/desorption.** This is the gain or loss of chemicals through exchange across surfaces. Adsorption may occur when the sample comes in contact with large surface areas such as the sampling container. Thorough decontamination of sample collection containers/monitoring equipment probes along with expedient transfer from the sample container to the labrotory container minimizes sorption effects.

- **Chemical reaction.** Dissolved chemical constituents may change due to reactions such as oxidation, hydrolysis, precipitation, etc. Proper preservation and adherence to holding times minimize these reactions.

- **Biodegradation.** Surface waters contain bacteria, some of which may be capable of altering the composition of contaminants. Proper preservation and adherence to holding time will reduce this effect.

- **Sample contamination.** Sample contamination is the most common source of errors and can result from several factors, including incomplete decontamination, contact with other samples, and contact with the atmosphere. Careful attention to decontamination, handling, and container sealing minimizes sample contamination.

5.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete water surface sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the surface water sampling task will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

6.0 TRAINING AND QUALIFICATIONS

Only qualified personnel shall be allowed to perform surface water sampling. At a minimum, Stantec employees qualified to perform water sampling will be required to have:

- Read this SOP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the OSHA 40-hour training course and/or 8-hour refresher course, as appropriate.
- Coordinated any proposed sampling activites with the laborotory to ensure proper sampling procedures.
- Previously performed water sampling in a manner generally consistent with the procedures described in this SOP.

Stantec employees who do not have previous experience sampling surface water will be trained on site by a qualified Stantec employee and supervised directly by that employee until they have demonstrated an ability to perform the procedures.

The Project Manager shall document personnel qualifications related to this procedure in the project QA files.

7.0 REQUIRED MATERIALS

Dedicated sampling equipment will be used whenever possible and stored at a designated location on site. Sample bottles for volatile and semivolatile organic compounds, general mineral, and metals samples will be obtained from the analytical laboratory. Extra sample containers will be obtained in case of breakage or other problems. Trip blanks will also be obtained from the analytical laboratory.

Typical surface water sampling equipment list:

- Access equipment such as waders or small boat.
- Sampler, selected on the basis of material constuction, target analyses, scope and environmental conditons.
- Sample processing equipment such as splitters or filtration systems, if necessary.
- Field Instruments (GPS, pH meter, YSI meter, etc.).
- PPE, including nitrile or powderless surgical gloves (or other material depending upon the nature of the chemicals encountered) and safety glasses. Tough work gloves may also be required for moving around equipment before or after the sampling itself. Other PPE include PFD, traffic vest, steel-toed safety shoes, hearing protection devices, long-sleeved shirt and long pants, and possibly a respirator if there is volatilization of chemicals, etc. Hip boots, chest waders, felt-soled boots, or tagline may also be applicable if wading is required;
- Auger, if collecting a sample through the ice.
- Water sample collection data forms.
- Data recording sheets/electronic storage device.
- Bound field notebook and pen (indelibile ink).
- Sample bottles with appropiate preservative, chain-of-custody forms, labels.
- Cooler with packing materials (bubble wrap, foam sleeves).
- Garbage bags for cooler liner and ziplock bags.
- Packing tape and shipping labels.
- Ice or frozen ice packs.

Proposed equipment for sample filtration, if filtration is needed:

- Two (2) clean containers, approximately one (1) liter in size.
- Organic-free deionized water.
- One Peristaltic filtration pump.

- In-line plate filter or capsule filter.
- Filter membranes--0.45 µ pore size for filter plate.
- A 1:1 nitric acid/purified water solution or 0.1 normal HCL for decontamination of filtering glassware.

Equipment used during decontamination:

- Alconox detergent (or equivalent non-phosphate detergent) or other solution that will neutralize the chemicals encountered.
- Organic-free deionized water or distilled water.
- Solvents, if required.
- Basins, brushes, wash bottles, paper towels, storage bags, drop cloths.
- PPE, including nitrile (or other material depending upon the nature of the chemicals we expect to encounter) or powderless surgical gloves and safety glasses/goggles. Tough work gloves may also be required for moving around equipment before or after the sampling itself. Other PPE include traffic vest, steel-toed safety shoes, hearing protection devices, long-sleeved shirt and long pants, and possibly a respirator if there is volatilization of chemicals, etc. An eyewash bottle or station, safety shower, and spill kit may be necessary if chemicals are used.

8.0 METHODS

This section describes the sequence of events to follow for sample collection in the field.

8.1 Sampling Location Selection

Prior to sample collection, field personnel must ensure the collected samples will be representative of the aqueous system being investigated. A representative sample typifies in time and space the portion of the aqueous system delineated by the scope and objectives of the study. Personnel must determine the number of sampling points to adequately represent the aqueous system's physical properties and distribution of chemical constituents or biological communities. When selecting surface water sampling sites:

- Consider the study objectives, types of data needed, equipment needs, and sampling methods.
- Consider locations with historical information.
- Consider physical characteristics of the area such as size and shape, land use, tributary and runoff characteristics, geology, point and nonpoint contamination

sources, hydraulic conditions, climate, water depth, volume, and fluvial-sediment transport characteristics.

- Collect water quality data (dissolved oxygen, pH, temperature, etc.) to aid in selecting the appropriate sampling depth.

8.1.1 Flowing Water Sites

Flowing water can refer to streams (fast, slow, intermittent, ephemeral, or perennial), canals, ditches, flumes (of all sizes and shapes), or any other surface water feature in which water moves unidirectionally. All or part of reservoirs and estuaries that flow unidirectionally are considered flowing water. Flowing water sampling sites are optimally located:

- At or near gauging stations to obtain surface water discharge data for determining constituent concentration relations (discharge should be measured at time of sampling if gauging station is not near the sampling site).

- In straight reaches having uniform flow and stable bottom contour where constituents are well mixed along the cross-section.

- At a distance above and below surface water confluences or point sources of contamination to avoid sampling a cross-section where flows are poorly mixed or not unidirectional (unless the point source is the subject of the study).

- Upstream of bridges or other structures to avoid contamination from the structure or roadway.

- At a location where samples can be collected at any water stage throughout the study period.

- At a location where other data are collected (suspended sediment, bedload, bottom material, or biological material).

8.1.2 Still Water Sites

Still water sites refer to all sizes and shapes of lakes, reservoirs, ponds, swamps, marshes, riverine backwaters, or any other surface water body that does not flow unidirectionally. Still water sampling sites are optimally located:

- Away from structures such as harbors, boat ramps, piers, fuel docks, and houseboats (unless the structures are part of the study).

- At locations with historical data.

8.2 Equipment Selection

When selecting the appropriate water sampling equipment, consider the following:

- The mechanical constraints of the equipment to perform under the environmental conditions (flow, temperature, etc).

- The ability of the equipment to obtain samples representative of the environmental conditions (size of sample, material).

- The compatibility of the sample and the equipment material in order to maintain sample integrity (equipment material with leaching and/or sorptive properties).

Common types of samplers include:

- Isokinetic depth integrating samplers: Accumulate a continuous water sample from a vertical section of the water column at a constant rate (independent of source velocity change) while transiting the vertical cross-section at a uniform rate.

- Nonisokinetic samplers: Sample enters the device at a velocity which differs from the ambient velocity (i.e., - open mouth samplers, Kemmerer sampler, etc.).

8.3 Equipment Decontamination

The decontamination protocol is essential to the quality of the sampling procedure and important to ensuring that chemicals remain at the project site and are not tracked or carried elsewhere. The decontamination procedure should be designed and constructed to work on the chemicals of interest and contain the rinsate and solids within the contamination reduction zone.

Before sampling begins, any non-dedicated or non-disposable equipment, probes, pumps, and pump hoses shall be decontaminated to remove contaminants, manufacturing residues, dust, and other foreign substances.

Decontamination will be performed on all sampling equipment that may contact potentially contaminated water, including water level probes, fiberglass tapes, etc. Clean nitrile gloves (or other appropriate material depending upon the chemicals involved) or powderless surgical gloves are to be worn during decontamination.

Each piece of sampling equipment will also be decontaminated with the appropriate solvent between each sample. The decontamination procedure for most equipment will be as follows:

- Disassemble sampling equipment, if applicable.

- Inspect equipment for stains, cuts, abrasions, and replace any necessary parts.

- Wash equipment in Alconox (or equivalent non-phosphate soap) and water solution, or appropriate solvent, using a brush or clean cloth to ensure removal of all contaminants.

- Rinse equipment in fresh tap water. Re-rinse with de-ionized water or distilled water.

- Dry equipment with paper towel and place in clean place, if appropriate.

The effectiveness of these decontamination procedures will be verified by QA/QC protocols, including equipment blanks, duplicates, and spikes.

8.4 Obtain Water Samples

The following general sampling procedure is to be used while collecting surface water samples:

- Assemble (if necessary) decontaminated sampling equipment;

- Don clean nitrile or powderless surgical gloves immediately before obtaining sample;

- Label sample containers;

- Record environmental conditions at the sampling point and record location with a GPS;

- Obtain water sample by using the appropriate sampling equipment for the scope of the activity (face the sampling apparatus upstream);

- Transfer sample water directly into pre-preserved sample bottles provided by the laboratory, maintaining a slow linear flow with as little aeration as possible. The individual sample bottles will be filled and immediately capped in the order given below or as required by the analytical protocol.

  - ❖ Volatile organic compounds (VOCs)
  - ❖ Semivolatile organic compounds
  - ❖ Priority Pollutant Metals
  - ❖ General Minerals

- After each sample is collected, place the bottles in self-sealing plastic or bubble bags, seal the bags, and immediately place the bags in a chilled cooler with ice or frozen ice packs.

- Record sample number, time/date of sampling, location, project number, method, weather, site conditions, and sampler on the Sample Collection Data Form.

- Complete chain-of-custody form for transportation of samples to lab.

- Hand deliver or ship samples to the lab on the same day they are collected, or as soon afterwards as possible.

8.5 Sample Filtration

The following filtering procedures shall be used on samples collected for filtered metal and general mineral analyses. Clean nitrile or powderless surgical gloves will be worn during this procedure.

- Select the appropriate capsule filter or place a new 0.45 filter membrane on the filter plate and assemble the (decontaminated) filter holder.
- Transfer information from sample label on the sample collected in the field (these samples will have been collected in sample bottles without preservatives) to new sample bottle (containing preservative, if appropriate).
- Place filtration tube in the sample bottle containing the unfiltered solution.
- Place new sample bottle (containing necessary preservatives) under filtering unit.
- Turn on pump and filter sample at less than 25 psi.
- Store filtered samples in chilled cooler with ice or frozen ice packs.
- Remove and dispose of used filter membrane.
- Rinse filtration plate and all parts of filtering apparatus that contacted the water sample with deionized water.
- Decontaminate any filtering glassware in an Alconox (or equivalent) solution, followed by rinses with tap water, a 1:1 nitric acid/purified water solution or 0.1 normal HCl, and finally organic-free deionized water.

8.6 Decontamination Methods

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed so that the solutions used are appropriate for the chemicals of concern.
- Personnel will don appropriate safety equipment to reduce personal exposure.
- Equipment that will not be damaged by water will be placed in a wash tub containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Equipment will then be rinsed in a second wash tub.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and wiped with organic-free deionized water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent possible contamination. Single use equipment and consumables will be discarded in an appropriate manner.

8.7 Sample Containers, Storage, and Holding Times

Refer to the Project SAP for project specific instructions on proper containers, storage of samples and allowable holding times.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

Outline quality control checking procedures, including frequency requirements and acceptance criteria. Acceptance criteria may take the form of an illustration such as a chart of acceptable results with tolerances, or other appropriate forms.

When collecting any required equipment blanks, ensure the appropriate water is used and that the water was not exposed to vehicle exhaust, cleaning fluids, or other solvents.

10.0 DOCUMENTATION

A record will be maintained during the sampling event will contain at a minimum:

- Project number.
- Station number.
- Date/time.
- GPS waypoint of sample site location in UTM.
- Site photographs.
- Crew members.
- Sampling method.
- Weather conditions.
- Instrumentation calibration log.
- Site conditions (i.e., nearby construction activity, discharge to watercourse from industry or agriculture, debris blocking channel, bank instability).

Sampling information in the field book should contain, at a minimum, the following:

- Sample name, location, time, sampler, analysis.
- Blind duplicates shall be noted on field notes (not chain-of-custody).
- Time of sample collection.
- Number of samples collected.
- Sample identification numbers.
- Preservation and storage of samples.
- Filtration performed, if any.
- Record of any QC samples from site.
- Any irregularities or problems that may have a bearing on sampling quality.
- Type of sampling equipment.
- Sampling procedure.
- Field observations.

In addition, proper documentation will include observance of the chain-of-custody procedures as described in the Project QAPP and SAP.

ACCEPTANCE

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Author/Originator

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Peer Reviewer

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Senior Reviewer

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Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

Accurate and thorough documentation of field work conducted by Stantec is a vitally important component of project operations. Field notes, and the validity of the records kept in them, comprise a significant portion of Stantec's work product. Field notes represent legal records of our services and require a corresponding level of care and professionalism regardless of the grade of the field note taker.

Field notebooks should be complete in the field and serve as a primary source of information enabling a third-party to easily reconstruct the chronology of field events, even if applicable field forms (i.e., chain-of-custody forms) are lost or destroyed.

This Field Notebook Standard Operating Procedure (SOP) has been prepared as guidance for collecting and managing field notes, such that these records are collected in a consistent manner throughout Stantec.

2.0 DEFINITIONS

COC	Chain-of-Custody
FSP	Field Sampling Plan
HASP	Site-Specific Health and Safety Plan
O&M	Operation & Maintenance
PPE	Personal Protective Equipment
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
QAPP	Quality Assurance Project Plan
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Field notes should be used as a medium to describe all activities occurring at a site when Stantec is present with or without subcontractors or other contractors on site. Field notes should reflect the following information, at a minimum, concerning site health and safety observations:

1. Ambient site conditions (i.e., operating facility versus barren land).
2. Weather.
3. Traffic patterns.
4. Tailgate/Toolbox safety meeting time, place, and reference for notes.
5. HASP location and use.
6. Specific Personal Protective Equipment (PPE) used on site.
7. Sampling activities, types of media sampled, areas and times.

8. Contractors, visitors, and client representatives on site.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Field notebooks should document the project quality assurance standards, referencing one or more of the following:

1. A project-specific FSP, QAPP, or combined SAP.
2. A project WP.
3. An O&M manual with written procedures.
4. An SOP for the specific tasks or task.
5. Forms or Checklists developed by a project team for a specific task.

The field notebook must not only record the daily quality assurance expectations for each task conducted but it should also reference the accepted standards of practice for both Stantec personnel and subcontractors in meeting these expectations.

5.0 RESPONSIBILITIES

With regard to field work documentation, the following are the minimum responsibilities for each position listed:

Project Manager – Responsible for:

- Ensuring project personnel performing field work understand the project quality assurance objectives and scope of work (i.e., SAP, QAPP, or WP and HASP).
- Managing resources (labor, equipment, materials, subcontractors) to be utilized, schedule, project number, project-specific field note requirements.
- Explaining expectations for communication with the home office (i.e., check-in phone calls, faxing field notes and forms).

Field Personnel – Responsible for:

- Reading and understanding project scope of work, schedule, and quality assurance documents prior to conducting field work.
- Maintaining copies of project documents, including the HASP.
- Diligently making routine entries in the field notebook concerning progress on site sampling activities, and deviations from the planned scope of work and activities of

Stantec, its subcontractors, or other contractors/visitors to the site, and any other information relevant to the work being conducted.

- Regular communication with the Project Manager throughout the day.

Health and Safety Officer – Responsible for:

- Periodic inspection of field notebooks for information relevant to potential site Health & Safety concerns, including use of PPE, monitoring instrument calibrations and use, and verification of training certificates from on-site personnel.

Project Quality Assurance Officer (if applicable) – Responsible for:

- Periodic inspection of field notebook(s) to ensure applicability of the field notebook for the project and the relevance of the notes collected.

- Management of field notebook in the field and project files in the home office following field work.

6.0 TRAINING/QUALIFICATIONS

Field personnel are expected to be experienced in the site-specific scope of work being performed through study and understanding of the project quality assurance standards prior to entering the field. While prior field experience on projects of similar scope and complexity is recommended, personnel maintaining the field notebook must record routine observations during field activities, and document non-routine events at the site in accordance with the project plans. Field personnel qualifications include legible penmanship, the ability to prepare clear illustrations and/or sketches of site features and activities, and the ability to responsibly manage field notebooks during and after field work.

7.0 REQUIRED MATERIALS

The following materials are required for proper field work documentation:

1. Field Notebook (e.g., Rite In The Rain, Composition, etc.) with numbered pages or Stantec field report forms.

2. Black or blue ink or indelible marking pen (e.g., Staedler Article No. 318-9 Lumocolor or equivalent).

3. Wrist watch or clock.

4. Project Quality Assurance documents or forms.

5. Mobile telephone or radio.

6. Communication log with pertinent contact information for key project (both Stantec and non-Stantec) personnel.

7. Site plan or map of area where work is to be conducted for reference purposes.

8.0 METHODS

The following protocol outlines a methodology to collect and manage field work documentation in a consistent manner throughout Stantec.

Multiple notebooks may be used for a project, perhaps concurrently, and the field note takers must coordinate with the Project Manager and Project Quality Assurance Officer (if applicable) to coordinate sequential numbering of field books.

1. Beginning of Project Day

The following entries should be made at the beginning of each project:

A. Note the project name, address and location, (i.e., off-site versus on-site, operable unit name, SWMU, etc.);

B. Note the governing documents including HASP, QAPP, WP, etc., for performing the work; and,

C. Note any specific activities planned for the day (e.g., drilling monitoring wells MW-1 through MW-4, removing a waste oil tank, completing a survey of sensitive habitat, or delineating a potential wetland, etc.).

2. Routine Events

The following entries should be made throughout each day, including:

A. Enter time (preferably at 15-minute increments) or starting and ending points (i.e., started drilling, completed well, etc.);

B. Enter description of location (well/borehole name, well being sampled, developed, tank being removed, area being cleared);

C. Enter description of equipment and materials in use and subcontractors working or on standby;

D. Note any specific activities to be completed for the day, and reference accompanying forms or attachments that need to be appended to the field note book in the order of occurrence. These might include:

- Tailgate meeting form;
- Subsurface clearance checklists;
- Equipment calibration;
- Borehole logs/well completion forms;
- Groundwater monitoring forms;

- Purge and sampling record;
- Chain-of-custody;
- Subcontractor (drillers/concrete cutters) daily reports;
- Equipment records; and,
- Supplies purchased (to be reported on expense report).

Or, for a construction/removal project:

- Air monitoring forms;
- Soil or rock tags;
- Bill-of-lading/waste manifests; and,
- Photographic log.

E. Note any variances to the project plan, project quality, or project delays;

F. Entries are to be made in ink and incorrect entries are to be changed only through strike-out, and then initialed by the note taker. Do not “scribble” or color over notes;

G. Notes must be factual, relevant and professional. No opinions or conjectures are appropriate. Observations and interpretations must be clearly distinguished within the context of the entry. Slang and editorial comments are inappropriate for field notebooks;

H. If photographs are taken, a photograph log should be maintained detailing the time the photo was taken, the name of the photographer, the direction of view in the photo, the content of the photo and any significant points to observe in photo; and,

I. Initial each page and sign and date the field notebook on the last page for each day.

3. Non-routine/significant events

A. Enter time (exact military time);

B. Record full yet concise description of any non-routine occurrence, such as an incident (i.e., spill, fire, motor vehicle accident) or other events (e.g., EPA inspection) beyond the scope of the scheduled work; and,

C. As applicable, multiple photographs should be taken to document the variance or incident.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Quality Control Checks are required at the following points during the field notebook documentation process:

1. Prior to entering the field, the Project Manager should ensure that field personnel have read the project quality assurance documents and that these are available for reference in the field;

2. At the end of each field day, personnel are responsible to forward copies of field notebook pages and supporting documentation to the Project Manager or designee;

3. At the completion of the phase of work and/or the end of the project, field notebooks must be assembled in the home office project file;

4. Working copies of filed notebooks should be used within the home office rather than the original notebooks; and,

5. Use referenced Stantec forms, as attachments, described in Article 10.0, Documentation.

10.0 DOCUMENTATION

The following information (referenced in the field notebook), drawings and/or forms, as applicable, should be provided via facsimile to the Project Manager daily (at a minimum) unless otherwise specified by the Project Manager:

- Photographs (i.e., color thumbnail digital photos).

- Equipment records.

- Revised maps and survey notes:

  - Corrections to existing site features (add new features; remove obsolete features), as applicable.
  - Placement of new wells/borings (with measured distances).
  - Preliminary ground water elevation contour map based on new data.

- Subsurface clearance checklist from HASP.

- HASP acknowledgement form, updated as needed.

- Chain-of-custody record.

- Variance/delay form (GEO-302).

- Waste management form (GEO-303).

- Borehole logs and well completion diagrams (GEO-304).

- Purging, monitoring, sampling, and development records (GEO-305).

The following documentation list is provided for use with this field note documentation SOP:

- Field Report GEO-301.

- Variance/Time Delay Form GEO-302.

- Waste Management Form GEO-303.
- Borehole log and well construction detail template GEO-304.
- Field Note Checklist GEO-601.
- Field Supplies Checklist GEO-602.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

Stantec	# Field Report	ERPA-301 Page 1 of 1 Rev. 1 Apr 2011

PC & OFFICE	DATE	PAGE	CLIENT
	PROJECT NO.	TASK NO.	SUBCONTRACTOR
TO:	LOCATION		
	WEATHER		TEMP.

CHRONOLOGY OF FIELD ACTIVITIES/ISSUES/OBSERVATIONS

EQUIPMENT USED:	SUBCONTRACTOR HOURS:	STAFF HOURS:
MILEAGE:	REVIEWED BY:	
cc:	PREPARED BY:	

Site Name ______________________________

Location ______________________________

Stantec Project No. ______________________

The purpose of this form is to document variances from the Work Plan scope or design specifications and/or document instances of time delays. Fax or deliver to the Stantec project office with the daily report. Please print legibly.

Variance / Time Delay Began	Variance / Time Delay Ended	Duration of Variance / Time Delay
________________	________________	________________
Date & Time	Date & Time	

Description of Variance

Work Plan Task / Spec Section __________

Reason for Delay AND/OR Variance

Stantec Personnel ________________________________

Print

Signature ______________________________ **Date** ________________

Stantec	# Waste Management Form	ERPA-303 Page 1 of 1 Rev. 1 — Apr 2011

Project Name ______________________ **Project Manager** ______________________

Site Location ______________________ **Project Number** ______________________

Date of Generation	Manifest/ Container No.	Waste Type	Type of Waste Container	No. of Containers	Volume of Waste	Company Responsible for Transportation	Date of Off-Site Transpor-tation	Disposal Facility	Waste Characterization Submitted To	Date of Submittal	Date of Disposal

At the end of a field work day, the field notebook should contain a detailed record of events, activities, developments, and personnel involved in the site work in the form of signed and dated entries as a legal record. As such, it must be complete and in sufficient detail that, if necessary, a person not at the site could reconstruct the day's events. Information that should be entered in the field notebook each day includes, as applicable:

- Date, including year.
- Project name, number, and location.
- Purpose of visit.
- A list of Stantec, client, agency, and subcontractor personnel on site.
- Relevant weather conditions (especially significant precipitation events, temperature, wind speed and wind direction) and significant changes throughout the day.
- Times during the day recorded in military time to mark events or significant milestones.
- Any unusual circumstances, observations, or occurrences.
- Communications with client or agencies, property owners, or managers.
- Subcontractor progress and/or problems and results of subcontractor inspections.
- Notes regarding any changes to or deviations from the FSP, QAPP, or HASP, with the rationale for changes.
- Observations such as species identifications or evidence of biological stress,
- Sampling or monitoring instruments used and all equipment calibrations.
- Results of measurements, such as sampler flow rate checks, VOCs, DO, temperature, pH, animal, or plant counts, etc. Record all non-detected values using the "less than" symbol and detection limit (*e*.g., <10 ppmv). Record all units of measure clearly.
- Equipment repairs or maintenance.
- Time of occurrence and nature of any equipment or mechanical malfunctions.
- A list of samples collected, noting sample number, sampling depths, analyses to be conducted, shipping date, time, and destination.
- Identification of quality assurance samples (blanks, duplicates, replicates, etc.).
- Chain-of-custody form numbers associated with each batch of samples shipped.
- Calculations (e.g., determination of monitoring well volumes, or ichthyoplankton net depth and sample volume).
- List of all photographs taken, giving a description of the subject matter, orientation of view, time, photographer's name, and image number.
- Initial each page and sign and date the field notebook on the last page for each day.
- "X" out any unused space on each page of the notebook.
- Strike out and initial any changes to the field notes.

Stantec	Field Supplies Checklist	ERPA-602	
		Page 1 of 1	
		Rev. 1.0	Apr 2011

	PLANNING MATERIALS
	Proposal/work plan
	Existing report data
	Cross-sections
	Site plan
	Phone list
	Access agreement
	ROW permit
	Shipping airbills

	NOTE-TAKING SUPPLIES
	Field notebook OR Field Report
	Aluminum clipboard
	Borehole logs/well diagrams
	Munsell color chart
	Surveying forms
	Sampling data forms
	O&M data forms
	Permanent markers
	Pencils
	Ruler
	Camera/film/digital storage
	Camera charger/batteries
	Protractor
	Calculator

	HEALTH & SAFETY SUPPLIES
	Health & Safety certifications
	HASP
	PPE card
	NIOSH Pocket Guide
	Hard hat
	Steel-toed boots
	Safety glasses
	Water resistant boots
	Reflective vest
	Insulated coveralls
	Rain suit
	Respirator and canisters
	Work gloves
	Nitrile gloves
	Latex gloves
	Viton gloves
	Tyvek suits
	Saranex suits
	Boot covers
	Vehicle safety light
	Barricades
	Traffic cones
	First aid kit/eyewash kit
	Face shield

	DISPOSABLE SUPPLIES
	Paper towels
	Aluminum foil
	Spray paint
	Trash bags
	Non-phosphate detergent
	Distilled water
	Cleaning brushes
	Funnel
	Ziploc® bags
	Duct tape
	Stakes
	Flagging
	Cooler
	Ice and/or blue ice
	Table/chair
	Sample tube cutter
	Socket set
	Pipe wrenches
	Screw drivers
	Knife
	Electrical tape
	Stainless trowel
	100-foot surveyor's tape
	Measuring wheel
	25-foot steel measuring tape
	Rock hammer
	Sledge hammer
	Pry Bar
	Shovel
	Hand auger
	Post hole digger
	Broom
	Snow shovel
	Flashlight
	Hand mirror

	METERS
	Water level meter
	Interface probe
	DO meter
	Eh meter
	pH meter
	Conductivity meter
	PID or FID
	Draeger pump & tubes
	O_2/CO_2 Meter
	Calibration solutions
	HACH kits
	Electrical multimeter
	Pitot tube kit
	Anemometer
	Magnehelic gauges
	Flow meter
	Cathodic protection meter

	SAMPLING EQUIPMENT
	Peristaltic pump
	Flexible tubing
	Tubing
	Flow-through cell
	1-inch bailers
	2-inch bailers
	4-inch bailers
	Stainless steel bailer
	Cotton string
	5-gallon buckets
	Purge trailer
	Sample vials
	Sample bottles
	Sample jars
	Air sampling tubes
	Metals filters
	Water/gasoline paste

	LABELS
	COCs
	COC seals
	Sample labels
	Drum waste labels
	Sample labels
	Drum waste labels

	SPECIALIZED EQUIPMENT
	Laptop
	Data logger/transducer
	Air compressor
	Air pump
	Pipe fittings
	Knockout drum
	Hoses
	Concrete mix
	Blower
	Generator
	Drill & bits
	Car battery
	Metal detector
	Auto level, tripod & rod
	Slug

ATTACHMENT B

Crimson Pipeline LP
Dominquez SPILL
SAMPLING FIELD DATA SHEET

Date of Sampling:
Arrival Time
Departure Time:

	Sample Type (Reg/Dup/ Trip/Equip)	Sample ID (ZV-XXY-ABB-CC)	Sample Location	Time (24:00)	Latitude	Longitude	Sample Type: Water/Soil/ Sediment (W/S/M)	Sample Type: Composite/Grab (C/G)	Sample Preservation (HCL/None)	Sample Equipment Type	Field Reading (ppmv)	Depth of Sample (bgs)	Comment
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

KEY: **Z = Activity Phase**	**X = General Location**	DC = Dominguez Channel	**Y = Media**	**A =Sample Point Type**	**BB = Boring Number**	**CC = Sample Depth**
N = Investigation Phase	FD = French Drain		W = Water	T = Transect		
C =Confirmation Phase	SL = Shell Lube		S = Soil	H = Hand Auger		
V or R= Duplicate, Otherwise left blank	YL = Youngstown Lateral	CB = Temp. TB = Trip EB = Equipment Blank	M = Sediment	G = Grab		

Notes:

GPS ID Number:	PID Serial Number:
Personnel on Site:	Field Instrument Calibration completed by
Signature:	Calibration Gas Type: 100 PPMV Isobutylene Pass / Fail

ATTACHMENT C

Irvine
17461 Derian Ave
Suite 100
Irvine, CA 92614
phone 949.261.1022 fax 949.260.3299

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Stantec Consulting Corp.	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_______ of ______ COCs
25864-F Business Center Dr.	**Analysis Turnaround Time**			Job No.
Redlands, CA 92374	Calendar (C) or Work Days (W) __________			
(909) 335-6166 Phone	TAT if different from Below _________			
(909) 335-6120 FAX	☐ 2 weeks			SDG No.
Project Name: Crimson Pipeline LP	☐ 1 week			
Site: Dominguez Channel	☐ 2 days			
P O #	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For __________ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time: